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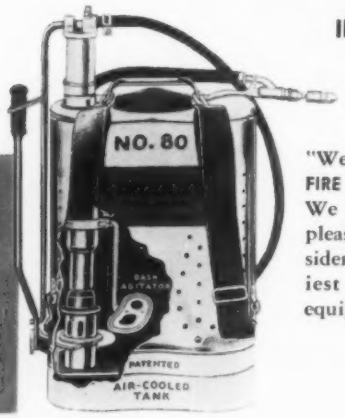

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Photo by Fred Landenberger, California Redwood Assn.

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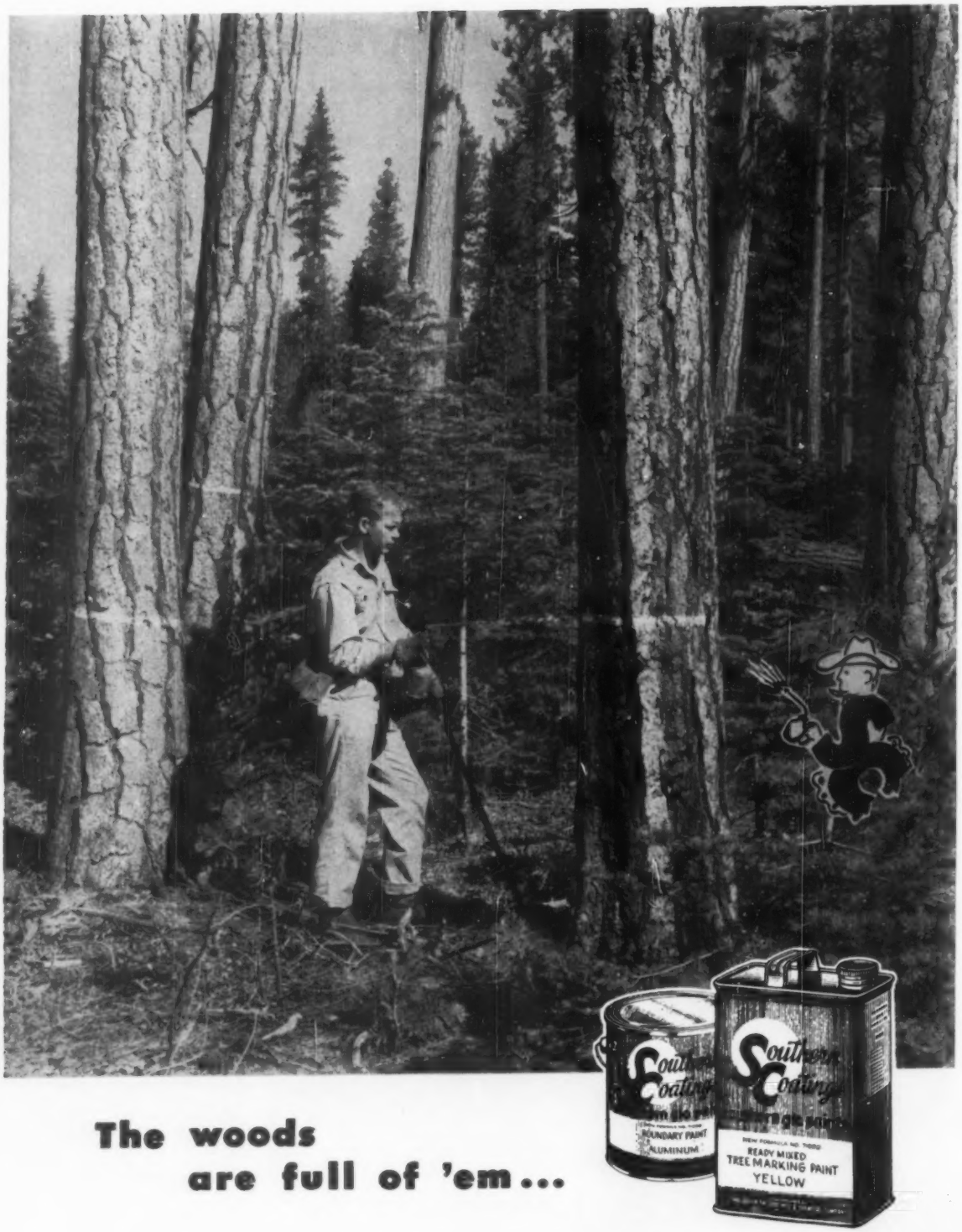

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Journal of Forestry

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The Soil Bank Act and Its Forestry Impact in Minnesota[1]

Robert Benson and
Richard A. Skok

WHILE the Soil Bank Act of 1956 has had its primary impact on the agricultural sector of our economy, the Conservation Reserve phase of that Act has had consequences within the forestry sector. These outcomes were the subject of a study conducted in central Minnesota in the fall of 1959.

The Conservation Reserve of the Soil Bank Act was aimed at removing land from agricultural use for a relatively long period of time. This was to be accomplished by placing cropland into what the Act termed "conservation uses." Specifically these uses include the establishment of such cover as grass, legumes, shrubs, or trees on the land. In return for diverting his cropland to these uses, the landowner was to be paid a portion of the cost of establishing the cover type chosen, and thereafter was to be paid an annual rent on this land for a period of time specified by a Soil Bank contract. Under the terms of this contract the landowner agreed to keep his land in this "conservation use" for the duration of the contract. In the case of tree planting contracts in Minnesota, this means for a ten-year period.

This study has tried to evaluate the tree-practice participation of the Soil Bank Act in a selected area of Minnesota in terms of the people, the land, and the institutions concerned. Such information should be useful in future considerations for extending this particular program or the development of new approaches to agricultural land retirement.

Procedure

A questionnaire was mailed to the 405 tree planting participants in the 20 counties which comprised the study area (Fig. 1). The names and addresses of all participants on record were obtained from the district foresters in three of Minnesota's State Division of Forestry areas. The records of the State Agricultural Stabilization and Conservation (ASC) Committee showed that the three areas from which these lists were compiled had the major portion of the Soil Bank tree planting participation.

Observations and the experience of field personnel responsible for administration of the tree planting practices were drawn on to aid in the formulation of a participant's questionnaire. In addition, the personal interviews conducted with these individuals complemented the information obtained through the mail questionnaire to provide a more complete picture of tree planting under the Soil Bank.

Usable returns were obtained from 81 percent of these participants. Because of this high proportion of response the results can be considered essentially free from non-response bias.

Tree Practice Participation

Approximately 27,000 acres of cropland in Minnesota have been placed under Soil Bank tree practice contracts from 1956-1960.[2]

The Minnesota Division of Forestry has been responsible for the provision of technical advice and administration of the tree planting practice under the Soil Bank Act. This included the provision of planting stock to participants.

Federal assistance for expansion of the state nurseries to take care of anticipated increased needs attributable to the Soil Bank has been provided. In addition, sufficient assistance was provided for one man to administer the program in the field plus some extra hours for seasonal employees to assist on Soil Bank work.

At the field level, the district forester in charge of farm forestry has directed and supervised Soil Bank tree planting. Field personnel received requests for work on Soil Bank contracts from the County ASC office in charge of local administration of the over-all program. The forester made recommendations on planting, was responsible for measurement of acreages contracted for tree planting to establish a basis for payments, and he certified that the planting had been properly carried out as provided under the Act.

Size of contracts.—The average acreage of land entered into a tree contract by participants was about 32 acres. This included the tree contract land on all farms owned by a given participant, and in-

THE AUTHORS are research assistant and assistant professor, respectively, School of Forestry, University of Minnesota, St. Paul.

[1]This paper is published as Scientific Journal Series Paper No. 4471 of the Minnesota Agric. Expt. Sta., St. Paul.

The authors wish to acknowledge the cooperation of John Childs, Robert Herbst, Wayne Hanson, and John Rodewald of the Minnesota Division of Forestry, and Sam Peterson of the Agricultural Stabilization and Conservation Office in Minnesota in carrying out this study.

[2]The 27,000-acre figure is the ASC total tree contract acreage for Minnesota, based on available figures for 1956-1959, and the best approximation of the Minnesota State Division of Forestry for 1960 tree contract acreage.

FIG. 1.—Area studied for tree contract participation.

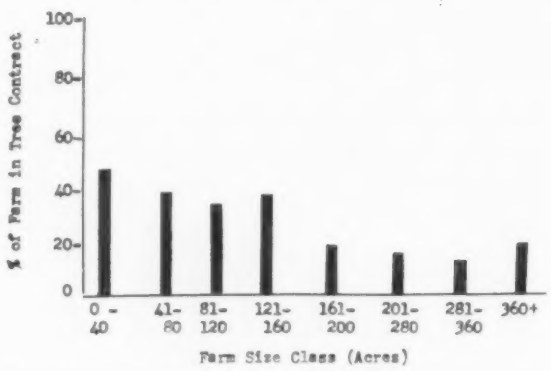

FIG. 2.—Percent of farm in tree contract by farm size class.

cluded all land contracted for trees whether the land had already been planted or was still to be planted at the time the report was made.

The proportion of the farm entered into such contracts was found to decrease with the increased size of the farm. Figure 2 shows this general trend. The absolute tree contract acreage averaged about the same regardless of the size of farm. Thus it was apparent that the decision relative to the acreage to be placed in tree contracts was not directly related to farm size.

Only one-third of the tree contract participants also adopted other Soil Bank practices. For those adopting other practices the average acreage under such contracts was 77 acres (median, 41 acres). There was a difference between the average acreage entered in tree contract on the farms that did and on those that did not adopt other practices. The average tree contract acreage on farms with "tree contracts only" was 40 acres, while that on farms adopting "other practices also" was 27 acres. Thus a substitution effect seems apparent.

This substitution effect is substantiated by the data in Table 1. As the tree contract size increased the proportion of the farm in tree planting increased while that entered into other practices decreased. Of importance in deciding between practices was the quality of land available for entry (better land with prospects of future agricultural crop production was more likely to be placed in the more flexible grass practices) and to some extent the lack of planting stock during the earlier Soil Bank years.

Delayed tree planting of land under contract.—Tree planting was delayed one or more years for 74 percent of the tree contracts issued in this area. Under provisions of the Act, a tree contract can be extended for up to five years when a justifiable delay in planting occurs. In effect many tree planting contracts will cover from 10 to 15 years because of planting delays.

A summary of the reasons cited for delay in tree planting is given in Table 2. The inability to obtain sufficient planting stock was by far the most often reported reason for delay. Shortages in planting stock for Soil Bank purposes made it necessary to limit the supply of state-produced nursery stock for any one individual participant to 10,000 seedlings per year during the early Soil Bank period. This occurred despite a diversion from current nursery production for planting on public lands to Soil Bank needs. As late as 1959, only one-half of the seedlings necessary for completion of planting under outstanding contracts were available for participants in the area studied.

The heavy reliance that participants placed on state nurseries is shown in Table 3. These nurseries provided over three-fourths of all the participants with seedlings. While many had not yet received their stock, they indicated they planned to obtain it from the state sources.

Although federal funds were made available for state nursery expansion to help meet Soil Bank created needs, there necessarily has been a time lag until such expansion could result in increased seedling output. This coupled with an apparent unwillingness to severely curtail other planting operations dependent on state stock has led to the delays in practice adoption.

TABLE 1.—PERCENT OF FARM ACREAGE IN TREE PLANTING PRACTICE AND OTHER PRACTICES BY TREE CONTRACT SIZE CLASS

Soil Bank practices	Tree contract size class (acres)					
	5	5-10	11-20	21-40	41-80	80+
	Percent of farm acreage					
Tree planting	7	14	18	34	57	58
Other	39	26	32	6	10	7
Total	46	40	50	40	67	65

TABLE 2.—FREQUENCY OF REASONS CITED BY PARTICIPANTS FOR DELAYED PLANTING

Reason for delay	Percent reporting[1]
Planting stock not available	87
Cost in excess of that could afford at one time	13
Desired to spread cost to reduce risk of planting failure	10
Technical assistance not available	3
Planting machine not available	2
Other	3

[1]Percentages are not additive because some participants cited more than one reason.

The Soil Bank program has helped to accelerate the expansion of Minnesota state nurseries. The increased nursery potential may prove to be one of the more important results of this Act in the forestry sector for this state. However, expansion will prove to be meaningless unless the state provides sufficient continuing maintenance and operating funds for utilization of these new facilities.

Participant's future plans for Soil Bank trees.—As would be expected, many participants were uncertain about the long-run aspects of Soil Bank tree plantations. About 25 percent indicated an intent to market Christmas trees from their plantings once the contracts expired.[3] The heavy reliance by participants on red pine and spruce for planting would indicate that perhaps even more plan a similar outcome.

The balance of the participants had only a vague idea as to what they planned to do with their plantations or planned simply to leave them alone. In general, participants seemed to be awaiting the termination of contracts before deciding on how best to plan with respect to the plantations. An opportunity and a challenge exists for the forestry profession to be able to provide these individuals with the information necessary for them to make decisions upon expiration of the contracts.

In some areas the development of these Soil Bank plantations along with other non-Soil Bank private plantings may be sufficient to create a market for established plantations containing as yet nonmerchantable timber. As knowledge about the potential of such land use is developed in the north and as transactions become more frequent, market prices may be reasonably well established. Such a development would provide these owners with alternatives through the sale of the stand or holding until it reaches product merchantability.

Participants and Their Farms

Length of ownership.—Ten years was the median period of participant ownership for farms entered in the tree planting practices, in whole or in part. Table 4 indicates that a disproportionately large percent of these farms were purchased in the early years, 1956-1958, of the Soil Bank. But this dropped considerably below the state over-all average in 1958-1959.

This reduction in the frequency of farm purchase for entry[4] into the Soil Bank tree practices may be attributed to several factors. Among the more important was the difficulty early tree practice participants had in obtaining nursery planting stock. This probably discouraged later participation by them as well as others. In addition, land prices had risen to the point where the annual Soil Bank payments were less attractive to buyers (i.e. the rental payments had been capitalized in the asking price). The Minnesota Farm Real Estate Report indicated that such a rise in farm land prices did occur.[5]

TABLE 3.—FREQUENCY OF PLANTING STOCK SOURCE CITED BY PARTICIPANTS

Planting stock source used	Percent reporting
State nurseries, only	76
Private nurseries, only	4
Both state and private nurseries	18
Other sources	2

TABLE 4.—FREQUENCY OF FARMS BY LENGTH OF OWNERSHIP AMONG TREE CONTRACT PARTICIPANTS AND LENGTH OF FARM OPERATION FOR ALL FARMS IN MINNESOTA

Period of ownership	Tree contract farms Base year 1959	All farms in state[1]
	Percent	
1 yr. or less	2	8
1 to 2 years	9	4
2 to 3 years	14	5

[1]U. S. Bureau of the Census. U. S. Census of Agriculture: 1954. Vol. 1, Counties and state economic areas, Part 8. U. S. Government Printing Office, Washington, D. C. 1956.

Multifarm ownership.—About 12 percent of the tree planting participants owned more than one farm. Of this group about one-third had owned all their farm land five years or more while another one-third had owned all their farm land less than five years. Among this latter group nearly all participants received their income primarily from nonfarm activities, thus the investment motive for participation seems apparent among this group.

[3]Under the provisions of the Soil Bank Act of 1956 the participant agrees to "harvest no crop from this land except timber under good forest management, or wildlife" while the contract is in effect. This is interpreted to mean no sale of Christmas trees or greens.

[4]The provision for the 1960 Soil Bank program specified that the land which had changed ownership within the past five years was not eligible for Soil Bank entry.

[5]Raup, Philip M., and Jerome E. Johnson. The Minnesota farm real estate market in 1957. Report No. 512. Department of Agricultural Economics, Institute of Agriculture, University of Minnesota, St. Paul.

Residence.—There was no major adjustment in residence for tree practice participants when comparing their pre- and post-Soil Bank entry status (Table 5). The net change that did occur found a reduction in the frequency of part-time residence on the farm but an offsetting increase in the frequency of full-time farm residents. On balance, there was no movement off farms for those adopting tree practices in the study area.

Income source of participants.—Some important changes were found in the primary source of income of these same participants, however. Table 6 presents the percentage of participants by the income sources they reported on a pre- and post-Soil Bank entry basis. The results show that farming has decreased in importance among the participants as a principal source of income. But most significant perhaps is that over the period of inquiry, less than 30 percent were found to be primarily dependent on the farm enterprise as a source of livelihood. The investment nature of the tree practices participation for those with other occupations and the desire for assured annual payments for an extended period (10 years) for retired participants would seem to be signified by these results.

Past forestry activities of participants.—In the study area, 58 percent of the tree practice participants reported they owned woodland other than that planted under the Soil Bank. Similarly, the *1954 Census of Agriculture* showed that 58 percent of all farms in these counties had woodlands. Thus, farms of participants were not unlike other farms in this respect.

The average woodland ownership of participants was 72 acres (the median, 40 acres). About 25 percent reported they had sold products at some time from their woodland while 36 percent utilized products on the farm from this source.

Many of the participants indicated an interest in forestry by their reported past activities summarized in Table 7. For many planting trees under the Soil Bank Act, it is apparent that this has been part of an over-all planting program of greater scope.

TABLE 5.—RESIDENCE OF TREE PRACTICE PARTICIPANTS PRE-1956 AND 1959

Reside on the farm	Pre Soil Bank 1956	Post Soil Bank 1959
	Percent	
None of the time	46	46
Part of the time	10	5
All of the time	45	50

TABLE 6.—PRIMARY INCOME SOURCE FOR TREE PRACTICE PARTICIPANTS

Previous income source	Pre-Soil Bank 1956	Post-Soil Bank entry 1959
	Percent	
Farming	29	16
Other occupations	61	68
Retired	3	10
Miscellaneous	5	5

Tree Contracts and the Forestry Sector in Minnesota

The 27,000 acres in Minnesota entered into tree contracts will be of little significance in reducing agricultural production. In a state with 18 million acres of commercial forest land, the 27,000 acres planted under this program seem quite insignificant relative to the over-all forestry sector of the economy.

The full measure of potential importance of these tree practice lands is not discernible merely by counting acres, however. The stands produced should be well-stocked because of the required certification of practice adoption by competent technical personnel. Timber produced on tree practice acreage should be of higher quality and greater accessibility than is typical for the area. Because only cropland is eligible for entry, these seem to be logical conclusions. Beyond this the provisions of the Soil Bank Act requiring the protection of plantations from fire and grazing may well instill a "guardianship" feeling in the participants toward their plantings. This probably will result in a higher receptivity by the owners to suggestions for management of their stands. Thus, qualitatively these entries to tree practices may be of significance not indicated by the acreage figures.

Technical assistance.—The tree practice option of the Soil Bank has brought a considerable number of people into contact with forestry personnel who might not otherwise have had such contact. In nearly all instances the participants were apparently satisfied with the competence of the aid received. Some indicated that they were very favorably impressed by this facet of their Soil Bank experience. The positive nature of the contact between the participants and forestry personnel may increase the interest of these landowners in forestry and result in a higher consideration for the forest land use alternative in future decisions.

While federal aid was given to help the state in providing the additional personnel needed to fulfill the tree practice created demands for assistance, such aid was not entirely sufficient to offset the workload imposed in the estimate of the personnel concerned. Thus, the necessity of meeting Soil Bank needs was at the expense of normal activities such as marking timber for sale or drawing up management plans for small woodland owners. To the extent that delayed activities of this nature were for woodland owners who were also Soil Bank participants, this has been a substitution effect and a reallocation in time of particular processes. But if the time spent on tree contracts was at the expense of woodland owners who had no interest in Soil Bank planting, the direct loss to them has been the delay of getting the desired aid or of undesirable decisions resulting from lack of advice otherwise available.

Future federal programs of this type should be more realistic in an appraisal of the costs of assistance in the forestry activities offered. Such effort should not be substituted for long term, carefully planned programs specifically oriented to forestry needs.

The Soil Bank as a tree planting

TABLE 7.—FREQUENCY OF PAST FORESTRY ACTIVITIES REPORTED BY TREE PRACTICE PARTICIPANTS

Activity	Percent reporting[1]
Tree planting (other than Soil Bank)	36
Pruning or thinning	30
Building of firebreaks or fencing against grazing	36

[1]Percentages are not additive because some participants reported more than one activity.

TABLE 8.—ACREAGE PLANTED TO TREES UNDER AGRICULTURAL CONSERVATION PROGRAM IN MINNESOTA[1] 1953-1958[1]

Year	Acres planted
1953	2,600
1954	1,188
1955	2,400
1956	2,300
1957	1,700
1958	1,400

[1]Data as reported in Agricultural Conservation Program Service (1959).

program.—In Minnesota there have been nearly one-half as many acres entered into plantations under the Soil Bank tree contracts from the 1956-1960 contract periods as were planted under the ACP from 1936-1958.[6]

Field personnel point out, however, that there was an increasing demand for planting stock even before the Soil Bank program began. The extent to which tree planting under this Act has been merely a substitute for planting under the ACP, the Tree Farm program, or through individual initiative is difficult to ascertain. Table 8 indicates that ACP tree planting in Minnesota has declined somewhat during the Soil Bank period for which data are available. This is probably a substitution effect. Undoubtedly the net gain in Minnesota acreage planted to trees was something less than the 27,000 acres entered under Soil Bank contract.

The questionnaire response showed a number of participants who probably would not have planted trees without Soil Bank assistance. Some indicated that the Soil Bank acted as a "kickoff incentive" for the beginning of a planned, continuing program of tree planting.

On a cost basis, it appears that the Soil Bank has been a more expensive tree planting program than the ACP. Table 9 shows an approximate comparison of major cost factors.

The calculations do not include the annual payments to landowners: at an average rate of $10 per acre per year for land in tree contracts, that outlay will be $2.7 million for 27,000 acres under ten year contract. Since most of the contracts have been extended through delays in planting the figure may actually be in excess of $3 million. These expenditures, however, should not be charged against tree planting. They are more logically offset against the benefits presumed in the removal of land and people from agricultural production—the principal intent of the Act.

One further observation relative to the influence the tree practice option has tended to have on tree planting programs in general: The shift of land to owners purchasing farms or additional farms in order to obtain qualified areas for entry into the Soil Bank has increased the number of landowners favorably inclined toward the forest land use alternative. The long-term outcome of this shift may be beneficial for the areas concerned. Much of this land is being returned to a use from which it should not have been taken.

Conclusions

The Soil Bank Act of 1956 has contributed a relatively small acreage of land to the forestry sector in Minnesota. The lack of available planting stock has delayed the planting of acreage in contract by nearly three-fourths of the participants. It is certain that this same factor has materially reduced the number of acres entered by Soil Bank applicants under this option.

In terms of the agricultural objective of this Act, it is regrettable that more adequate provisions were not made to overcome this shortage of seedlings. Tree cover was the most permanent land retirement option available to the participants and thus offered the best opportunity for reduction in crop output over long periods of time for lands removed from production.

No important shifts in residence status were noted among tree practice participants. Fewer were found to rely on farming as their principal source of income, after

TABLE 9.—COMPARISON OF COSTS OF TREE PLANTING UNDER SOIL BANK AND ACP IN MINNESOTA

Soil Bank Program	
Tree contract acreage, Minnesota (through 1960 contracts)	27,000
Practice payment per acre (cost-sharing payment for planting)	$20.00[1]
Cost of planting	$540,000.00 (A)
Time for planting	5 years[2](B)
Assumed costs for planting 27,000 acres under ACP	
ACP cost sharing per acre	$10.05[3]
Cost to plant Soil Bank trees in ACP	$271,350.00 (C)
Number of years to plant 27,000 acres at typical ACP rate	13 years[4](D)
Differential:	
Cost of planting under Soil Bank rather than ACP (A-C)	$268,650.00
Time gain in planting under Soil Bank (D-B)	8 years

[1]Estimated costs by administrative personnel.
[2]This assumes all tree contracts will be completed by 1961.
[3]Agricultural Conservation Program Service (1959).
[4]Based on average acres of trees planted in ACP from 1953-1956, Agricultural Conservation Program Service (1959).

[6]From 1936-1958 there were 56,038 acres of tree and shrub planting in Minnesota under the ACP (Agricultural Conservation Program Service. Summary by States: 1958. U. S. Dept. Agric., Washington, D. C. 1959. p. 92).

entry into the Soil Bank tree contracts. A relatively small portion (29 percent) were dependent on farming even prior to the program. Some activity in purchasing farms for entry into tree contracts (as well as other options) was noted in this area in the first two years of the Act. However, such transactions were nearly non-existent by the 1959 contract period. Certainly the investment motive appeared as a strong factor among tree practice participants and the long period contract was highly attractive to those retired from work. There was some indication that equivalent or greater participation in the tree practice option would have been possible by an extension of the contract period to perhaps 15 years and a reduction in annual payments. The period of assured income was more significant than its level to a sizable group of participants.

It is difficult to assess the value of this program relative to its cost because of the multibenefit nature of the output. When compared with other cost-sharing programs of the past, it has been an expensive means of accomplishing tree planting. The years of time purchased in the more rapid establishment of plantations may or may not prove to balance out against the added costs.

A need for "follow-up" activity on these plantations and for encouragement of adequate management practices based on the most beneficial outcome in terms of the owners' objectives seems apparent. This will be most important about the time contracts expire ten years hence. Major decisions influencing the future of these stands will occur at that time. Considering the large investment society already has made on these acres, the relatively small additional outlay that such a policy would require would be well justified.

Correction

In Part II of the article "The Society of American Foresters: An Historical Summary," published in the October 1960 issue of the JOURNAL, the following corrections should be made on page 778 under the subheading "The Schlich Memorial Medal":

The date of the award of the medal to Herman H. Chapman should be 1948 and the name of Ralph S. Hosmer should be listed as the 1950 recipient.

Contents and Title Page Bound in JOURNAL

Table of Contents and Title Page for Volume 58 will be found in the back of this issue. For binding purposes the complete section can be removed by opening the staples.

The Inheritance of Crooked Stem Form in Loblolly Pine (Pinus taeda L.)

Thomas O. Perry

THERE HAVE BEEN many reports in the literature on the racial differences in degree of bole straightness of conifer species (*1, 2, 3, 4, 8, 9*). McWilliam (*5*) has reported on inheritance of crooked stem form for loblolly pine in Australia. Mergen (*6*) discussed the probable inheritance of stem deformities in slash pine. Through 1953, however, no studies appeared to have been made specifically to determine the inheritance pattern of crooked stem form in American pine species. In January 1954 a number of crosses between straight and crooked loblolly were made at the University of Florida. The object of making these crosses was to gain additional information regarding the number and kinds of genes that function in controlling straight versus crooked stem form in pine species.

Materials

The study was given added incentive through the location of a natural stand of extremely crooked trees near Gainesville, Fla. A number of residences have been established in this stand. All trees in the stand showed varying degrees of helical crook throughout the entire length of their trunks. The branches on many of these trees also showed helical crookedness. Indeed, leaders of forked trees in the stand continued to spiral synchronously above the point of forking. Even the most conservative observers have conceded that heredity must have been the major cause of the poor form of the stand. The only questions were as to the heritability of the trait and the number of genes involved.

Two of the most crooked trees in the stand (Figs. 1 and 2) were selected as parent trees C_1 and C_2 in the investigation; Figure 3 shows the extreme of crookedness resulting from crossing these trees. The parent trees were too crooked to be climbed with a ladder and climbing ropes were used to make the controlled pollination.

Locating two "perfectly" straight trees on the nearby Austin Cary Forest was a difficult task as most loblolly pine trees are crooked to some degree. Parent trees S_1 and S_2, however, were essentially straight; no crook could be detected by looking along the trunk of the tree from base to top.

In March 1954 a presumably sufficient number of pollinations were made to provide ample progenies for the determination of Mendelian ratios. All of the possible cross combinations including self pollinations were made among C_1, C_2, S_1, and S_2. Insects and other factors, however, drastically re-

FIG. 1.—Tree C_1. Loblolly pine tree of extremely crooked form used in cross with tree C_2, to study the inheritance of crooked stem form in loblolly pine.

FIG. 2.—Tree C_2. The second crooked tree used in the study of the inheritance of crooked stem form trees C_1 and C_2 are located in the same natural stand. All trees in this stand show varying degrees of crooked stem form.

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The author wishes to acknowledge the work of his graduate students, George Meskimen, Dan Schmidt, and Frank Sorenson. To them goes the credit for devising a reasonably objective scoring system for crooked stem form and making the final measurements and analyses upon which the report is based.

FIG. 3.—Extremely crooked individual of progeny of cross between tree C_1 and tree C_2. All branches of this tree are as contorted as the leader.

duced the final yield at the time of harvest in the fall of 1955.

Seed from the controlled pollinations was sown in the nursery during the spring of 1956. The resulting seedlings were outplanted in the spring of 1957. The outplanting design included five replications. There was a variable number of seedlings available, but each parent combination was represented by five or more seedlings in each block.

Loblolly pine seedlings were obtained from a nearby Florida state nursery and included in the planting for comparative purposes. No positive record of the geographic source of the seed used by the state nursery was available. However, past purchasing records indicate that the seed was obtained from somewhere in the west-central part of Georgia.

By the fall of 1958 the average height of the planted trees was approaching 2.5 meters and many trees were more than 3 meters tall. Differences in stem form and height among the progenies were apparent. Growth of the seedlings was more than sufficient to mask any effect of initial seed size or cultural treatment. Therefore, in the fall of 1958, the surviving stock was measured and analyzed for differences in height and crookedness.

Methods of Measurement

Height was measured to the nearest centimeter with a meter stick.

A scoring scale was developed to assess crookedness. The score for each tree was computed as follows:

The number of crooks per meter of bole times ten plus the magnitude of the crook nearest breast height in centimeters times 10 plus one point for excessively crooked branches plus one point for a crooked leader, equalled the total score for crooked stem form. If past terminal damage was detected, the total number of crooks recorded was reduced by one. If, in addition, such a tree had a crooked leader the final score was reduced by one point. The degree of crook at breast height was determined by measuring the maximum deviation perpendicular to the axis of the bole above and below the crook. The measurement was made from the exterior surface of the bole to the interior surface of the crook (Fig. 4). The total number of crooks recorded was the consensus of three observers, each of whom made an independent count. (Fig. 3, as previously noted, illustrates an extremely crooked individual from the progeny of the cross between two crooked parents, C_1 and C_2.) Forked trees were not included in the analyses for crookedness because the observers could not agree on whether the forking in any given case was due to past damage or was an expression of crookedness. There were only five such trees, and they were included in the height analysis. Finally, there were four trees so stunted and misshapen and bushy that they were not included in either analysis.

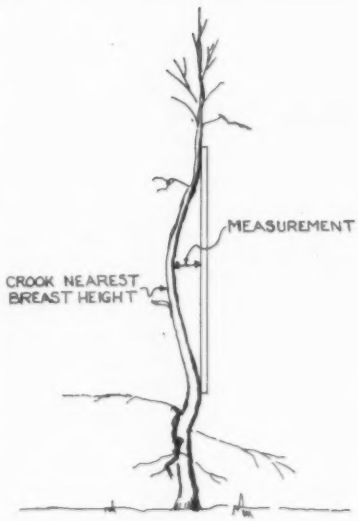

FIG. 4.—Sketch showing the manner of measurement for determining degree of crook at breast height.

Because of the unequal amounts of seed produced by the pollinations, and of subsequent mortality, there were different numbers of trees representing the various crosses; in fact, two of the crosses (C_1xS_1 and S_2xO) could be

TABLE 1.—ANALYSIS OF VARIANCE FOR CROOKEDNESS[1]

Source	Degrees of freedom	Sums of squares	Mean squares	F-value
Blocks	4	78.18	19.54	.62
Progenies	5	765.98	153.20	4.85**
Error	20	631.96	31.60	

[1]Crosses C_1xS_1 and S_2xO were omitted from the analysis; the analysis is based on individual block means of 5 crosses and of state nursery stock on 5 balanced randomized blocks.

**Probability of an F-value as high or higher occurring by chance is less than 1:100.

TABLE 2.—COMPLETE ANALYSIS OF VARIANCE FOR CROOKEDNESS[1]

Source	Degrees of freedom	Sums of squares	Mean squares	F-value
Blocks	4	745	186	1.56
Progenies	7	7,383	1,055	8.86**
Interaction	28	4,313	154	1.29
Error	236	28,193	119	

[1]All crosses were included in the analysis and the progeny means were adjusted to account for the differences in the number of observations contributing to each of the progeny means.

**Significant at the 1 percent level of confidence.

represented in only part of the blocks. Consequently, two approaches were made to the statistical analysis of the data. In the first approach the two incompletely represented crosses were disregarded and an analysis of variance calculated from the individual-block progeny means for the five completely represented progenies and the state nursery stock. In the second analysis all the data were used and the progeny means representing the observations in every block were adjusted (the method adjustment was that of Snedecor)[1] to account for the differences in number of observations contributing to each of the means.

Since trees C_1 and C_2 were the only two parents represented by reciprocal crosses, the progenies from these crosses were pooled and the pooled data were used in both types of analysis.

TABLE 3.—PROGENY MEANS FOR CROOKEDNESS

Cross	No. of individuals scored[1]	Adjusted average score for crook	Unadjusted average score for crook	Low individual score for crook	High individual score for crook
C_1xC_2 and C_2xC_1	81	30.59	30.13	0.0	65.9
C_2xS_2	15	28.33	28.10	10.8	80.6
S.N.	69	22.54	22.72	0.0	53.0
S_1xO	21	21.59	21.60	11.4	41.6
C_1xS_1	14	19.14	18.90	0.0	26.2
C_2xO	39	18.59	18.66	9.9	37.6
S_2xO	10	16.52	16.47	0.0	31.8
S_1xS_2	27	16.42	16.44	0.0	39.4

Explanation of symbols:
C_1 = crooked parent; C_2 = crooked parent; S_1 = straight parent; S_2 = straight parent; O = open pollinations; S.N. = state nursery stock.
[1]The number of individuals scored (column 2) is the same for both columns 3 and 4.

Results

Table 1 presents the analysis of variance for crookedness for the progenies of the five crosses and the state nursery stock. Differences between progeny means scores were highly significant.

Adjustment of the progeny means scores and the progeny variance did not change the over-all results. Table 2 presents the results of the complete analysis of the data, and Table 3 gives the unadjusted and corresponding adjusted progeny means scored for crooked stem form. The significance of the differences between the progeny means scores for crooked stem form was tested using Duncan's Rank and File Test.[2] The results of these tests are given at the 5 percent level in Table 4 and at the 1 percent level in Table 5. Comparisons for each degree of freedom available for progenies and results of classic *t* tests based on these comparisons give similar results.

Table 6 is an analysis of height data from the progeny of the five crosses represented in all five blocks and the state nursery stock of the same age. Differences between progenies are highly significant. Block differences are not significant. An analysis of variance for the complete set of data adjusted by the method of Snedecor is given in Table 7. Progeny differences are again highly significant; however, the effect of including all progenies in the analysis is to make the differences between blocks highly significant. Table 8 gives the unadjusted and the corresponding adjusted progeny means for height. Significance of the differences in the mean height of the different progenies was tested using Duncan's Rank and File Test. Results of these tests at the 5 percent and 1 percent level of confidence are given in Tables 9 and 10. Again, comparisons made for each degree of freedom available for progenies and results of classic *t* tests based on these comparisons yield similar results.

Discussion

The original pollinations were made for all possible cross combinations and theoretically would provide 500 or more seeds from each cross. Various mishaps limited the size of the progeny population available for final analysis. Indeed, some cross combinations for example, C_2xS_1, C_1xS_2 and C_1xO, did not yield enough seed to warrant their inclusion in the out-

[1]Snedecor, George W. Statistical methods. 5th ed. pp. 388-391. 1956.

[2]Biometrics 3:11, 1955.

TABLE 4.—THE SIGNIFICANCE OF DIFFERENCES BETWEEN PROGENY MEAN SCORES FOR CROOKED STEM FORM. DUNCAN'S METHOD: 5% LEVEL OF CONFIDENCE

Differences between all means underlined by the same line are not significant; therefore, the significant differences are:
At the 5% level of confidence:
C_1xC_2 is more crooked than S_1xS_2, S_2xO, C_2xO, C_1xS_1 and S_1xO
C_2xS_2 is more crooked than S_1xS_2, S_2xO, C_2xO and C_1xS_1

	Treatment means by rank							
Progeny	C_1xC_2	C_2xS_2	S.N.	S_1xO	C_1xS_1	C_2xO	S_2xO	S_1xS_2
Adjusted mean score for crook	30.59	28.33	22.54	21.59	19.14	18.59	16.52	16.42

TABLE 5.—THE SIGNIFICANCE OF DIFFERENCES BETWEEN PROGENY MEAN SCORES FOR CROOKED STEM FORM. DUNCAN'S METHOD: 1% LEVEL OF CONFIDENCE

Differences between all means underlined by the same line are not significant
At the 1% level of confidence:
C_1xC_2 is more crooked than S_1xS_2, S_2xO, C_2xO, C_1xS_1 and S_1xO
C_2xS_2 is more crooked than S_1xS_2 and S_2xO

	Treatment means by rank							
Progeny	C_1xC_2	C_2xS_2	S.N.	S_1xO	C_1xS_1	C_2xO	S_2xO	S_1xS_2
Adjusted mean score for crook	30.59	28.33	22.59	21.59	19.14	18.59	16.52	16.42

TABLE 6.—ANALYSIS OF VARIANCE FOR HEIGHT[1]

Source	Degrees of freedom	Sums of squares	Mean squares	F-value
Blocks	4	3,025.69	756.42	1.91
Progenies	5	19,320.18	3,864.04	9.78**
Error	20	7,902.21	395.11	
Total	29	30,284.08		

[1]Crosses C_1xS_1 and S_2xO were omitted from the analysis; the analysis is based on individual block means of five crosses and of state nursery stock on five balanced randomized blocks.

**Significant at the 1 percent level of confidence.

TABLE 7.—COMPLETE ANALYSIS OF VARIANCE FOR HEIGHT[1]

Source	Degrees of freedom	Sums of squares	Mean squares	F-value
Blocks	4	46,162	11,540	6.36**
Progenies	7	154,358	22,051	12.16**
Interaction	28	55,341	1,976	1.09
Error	241	438,946	1,813	

[1]All crosses were included in the analysis and the progeny means were adjusted to account for the differences in number of observations contributing to each of the means.

**Significant at the 1 percent level of confidence.

TABLE 8.—PROGENY MEANS FOR HEIGHT

Cross	Unadjusted	Adjusted
S.N.	233.1	232.7
C_1xC_2	255.4	256.3
C_1xS_1	261.6	265.3
S_2xO	264.0	260.8
C_2xO	267.2	266.2
C_2xS_2	279.0	280.3
S_1xS_2	283.5	283.1
S_1xO	308.8	309.9

planting design. None of the self-pollinations yielded viable seed. None of the cross combinations yielded a progeny large enough for determining a Mendelian ratio. However, the results clearly demonstrate the significant role that genetics plays in controlling the stem form of loblolly pine.

There is a continuous gradation of crookedness displayed by the progeny populations. Some individuals from the crosses between straight trees (S_1xS_2) were very crooked while some individuals from the crosses between crooked trees (C_1xC_2) were very straight. The range in degree of crookedness is given in Table 3. This transgressive variation and the continuous variation within progenies is strong evidence that several genes are involved in determining the degree of crookedness of a loblolly pine tree. The transgressive variation also indicates that none of the parents tested was homozygous for straight or for crooked form traits.

The continuous variation in degree of crookedness of individuals within progenies makes impossible the statement that any given individual is absolutely straight or crooked. Straightness and crookedness can only be defined arbitrarily. If an extremely rigorous standard of straightness is established, we find that the straight or almost straight trees score 16.5 points or less by the scoring system. Table 11 gives the percentage of crooked and straight trees for each progeny in accord with this arbitrary standard of 16.5 points. Progenies are ranked in both Tables 3 and 11. Note the change in rank when progenies are arranged in accord with the percentage of straight versus crooked trees in contrast to the ranking when the progenies are arranged in accordance with the average score for straightness.

When an arbitrary score of 16.5 is established, we find that there are more than four times as many straight individuals in the progenies produced from the cross between straight parents than there are in the progenies produced between crooked parents. Note that, with the rigorous standard of straightness, only 48.2 percent of the individuals in the progeny from the straight×straight cross (S_1xS_2) are classified as straight. However, the raw data reveal that only one individual or 3.7 percent of the 27 individuals from the straight × straight progeny was as crooked as the average individual of the crooked × crooked progeny.

The difference between the average crookedness of the state nursery seedlings and the average crookedness of the progeny from the straight × straight cross (S_1xS_2) was not significant at the 5 percent level. The difference is significant at the 10 percent level of confidence. However Table 11 reveals that there are 1.4 times as many straight trees in the progeny from the straight × straight (S_1xS_2) parentage than there are in the population of state nursery seedlings. A check of the raw data reveals that only 22 percent of the progeny from the cross between straight trees are as crooked as the average seedling from the state nursery.

Although the experiment was not designed to study the genetic control of height, growth and vigor, the analysis of variance in Tables 6 and 7 reveals that there are highly significant differences in the heights of the progenies produced by the different crosses. The state nursery seedlings are 9 to 33 per-

TABLE 9.—THE SIGNIFICANT DIFFERENCES BETWEEN PROGENY MEANS HEIGHTS. DUNCAN'S METHOD: 5% LEVEL OF CONFIDENCE

Differences between progeny means underlined by the same line are not significant. The state nursery seedlings are significantly smaller than progenies of all crosses except C_1xC_2 (the crooked x crooked cross). S_1xO progenies are significantly larger than all other cross combinations. C_1xC_2 seedlings are significantly smaller than the S_1xS_2 seedlings.

Treatment means by rank								
Progeny average	S.N.	C_1xC_2	S_2xO	C_1xS_1	C_2xO	C_2xS_2	S_1xS_2	S_1xO
Height	232.7	256.3	260.8	265.3	266.2	280.3	283.1	309.9

TABLE 10.—THE SIGNIFICANCE OF DIFFERENCES BETWEEN PROGENY MEANS HEIGHTS. DUNCAN'S METHOD: 1% LEVEL OF CONFIDENCE

Differences between progenies underlined by the same line are not significant. Therefore, at the 1% level of confidence the significant differences are:

S.N. vs C_2xS_2, S.N. vs S_1xS_2, S.N. vs S_1xO, C_1C_2 vs S_1xO S_2xO vs S_1xO, C_1xS_1 vs S_1xO, C_2xO vs S_1xO

Treatment means by rank								
Progeny average	S.N.	C_1xC_2	S xO	C_1xS_1	C_2xO	C_2xS_2	S_1xS_2	S_1xO
Height	232.7	256.3	260.8	265.3	266.2	280.3	283.1	309.9

TABLE 11.—THE PERCENTAGE OF TREES IN A PROGENY THAT ARE STRAIGHT OR CROOKED[1]

Cross	Percent of crooked trees	Percent of straight trees
C_1xC_2 & C_2xC_1	88.5	11.5
C_1xS_1	78.4	21.5
C_2xS_2	73.3	26.7
C_2xO	66.7	33.3
S_2xO	66.6	33.4
S.N.	65.2	34.8
S_1xO	57.1	42.9
S_1xS_2	51.8	48.2

[1]A tree with a score greater than 16.5 is arbitrarily classified as crooked and a tree with a score of less than 16.5 is arbitrarily classified as straight.

cent smaller than all other progenies included in the test. The poor performance of the state nursery seedlings probably is a reflection of racial differences between the west-central Georgia seed source of loblolly pine and the local population of loblolly pine in Gainesville, Fla.

Tables 9 and 10 reveal that there are significant differences in the height growth of individual progenies within the local Gainesville population.

The progeny of the cross S_1xO is 21 percent taller than the progeny of the C_1xC_2 cross. The seedlings from the cross between trees S_1 and S_2 are 10 percent taller than the seedlings from the cross between trees C_1 and C_2. These differences in height growth reflect even greater differences in volume growth. The article on the value of genetically superior seed by Perry and Wang (7) indicates that the theoretical increase in volume at 25 years from raising trees from the S_1xS_2 cross would justify paying $90 more per pound for this seed than for seed of the C_1xC_2 cross. It is difficult to assess the added benefits that would accrue from the fact that the S_1xS_2 cross produces 4 times as many straight offspring. The yield of poles and piling would be multiplied accordingly and the amount of compression wood would be considerably reduced. The theoretical increase in profits resulting from the use of S_1xO and S_1xS_2 seedlings rather than those commercially available through the state nursery might approach $270 per pound of seed.[3]

These results give basis for optimism regarding the improvements that will be obtained through the various tree selection and seed orchard programs of the southern United States.

The results of the study happily indicate that there is no significant correlation between average height growth and crooked stem form ($r = 0.12$ on 6 degrees of freedom).

Summary

The results of crosses between crooked and straight trees indicate that genetics plays a major role in the development of straight or crooked trees. Crosses between straight parents yielded four times as many straight trees as did crosses between crooked parents. Only 3.7 percent of the progeny from the straight parents were as crooked as the average individual from the progenies from crooked parents.

The progenies involved in the test were too small for the determination of Mendelian ratios. However, the transgressive and continuous pattern of variation within all progenies gives strong evidence that a number of genes are involved in the control of stem form characteristics.

[3]Cuttings or seeds from these trees are not available for commercial use.

Although the progeny test was not designed to reveal genetics differences in growth rate between individuals, significant differences of 10 to 20 percent were found to exist between progenies of local origin. All progenies of local origin gave a 9 to 30 percent greater growth than state nursery seedlings included as controls in the study. The poor performance of the state nursery seedlings probably reflects a racial difference between loblolly pine from west-central Georgia and loblolly pine from the Gainesville, Fla. area.

The progenies included in this experiment reveal no significant correlation between crooked stem form and height growth.

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A New Forest Fire Retardant—Swelling Bentonite Clay

Clinton B. Phillips and Harry R. Miller, Jr.

LABORATORY and field tests a few years ago (*2, 4, 7*) established sodium calcium borate as the most effective fire retardant available for forest fire suppression. Since 1956 forest fire fighters have used this material with increasing success (*1, 6*). Further screening tests of several materials indicated that swelling-type bentonite clay might be superior in some respects to sodium calcium borate (*5*) and led to a comparative study of the two materials.

This study, made in 1958,[1] showed that swelling-type bentonite clay, commonly used in oil well drilling mud, is a good forest fire retardant. Mixed with water, it sets up into a stable gel and retains water tenaciously for periods up to 2 or 3 hours under summer drying conditions (Fig. 1). During that time bentonite appeared to be at least as effective as sodium calcium borate. Beyond that time it could not be depended upon as a retardant. Bentonite slurry is much cheaper than borate and provides much the same drop pattern from air tankers.

The evaluation of bentonite as a forest fire retardant is based on laboratory tests of ignition and radiant heat energy output, on grass plot tests, on brush pile tests, and on observations of air tanker drops made on wildfires.[2]

Laboratory tests.—A mixture of .94 pounds of bentonite per gallon of water was used for all laboratory tests. These tests were made before field trials showed that a thinner mix was desirable for ease in pumping the slurry.

One series of tests compared the time required to ignite retardant-treated and water-treated wooden dowels at muffle furnace temperatures of 1,000°F., 1,200°F., 1,500° F., and 1,700°F. (*3*). Separate tests were made with dowels dried 1, 2, 3, 4, and 5 hours. The results can be summarized as follows:

1. Bentonite and borate were both more effective than plain water in retarding ignition at all oven temperatures and for all drying periods.

2. Bentonite was more effective than borate in retarding ignition at temperatures of 1,000°F., and 1,200°F. for all drying periods.

3. Bentonite was more effective than borate in retarding ignition at 1,500°F., and 1,700°F. for 1 and 2 hours of drying. After 2 hours borate was more effective.

Another series of tests compared the ability of the chemical retardants and water to decrease radiant heat energy output from burning dowels. Separate tests were made with dowels dried 1, 2, 3, 4, and 5 hours. In summary, the tests showed:

1. Bentonite was more effective than borate or water in reducing both total radiation and peak radiation for all drying periods.

2. Borate was more effective than water in reducing both total radiation and peak radiation for all drying periods.

Grass plot tests.—Bentonite was compared with borate on grass plots having extremely dry, heavy grass and other annuals which produced hot fires on all plots (Fig. 2). Plots treated with each type of retardant were burned after 1, 2, 3, and 4 hours of drying. Air temperature during the tests in September varied from 83°F. to 95°F.; relative humidity from 37 percent to 18 percent. There was little or no wind.

The retarding effect of bentonite and borate on these test fires (Fig.

FIG. 1.—The slurry of swelling bentonite clay readily coats various surfaces and holds a large amount of water in place for periods of 2 to 3 hours.

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[1]Tests were conducted in California by the Pacific Southwest Forest and Range Expt. Sta., Division of Forest Fire Research. Cooperators in the field tests included Region 5, U. S. Forest Service; Arcadia Equipment Development Center, U. S. Forest Service; California Division of Forestry; and Los Angeles County Fire Department.

[2]The procedures used to test swelling bentonite clay in the laboratory and in the field and the details of the results obtained are included in another report (*9*).

3) was as follows:

Drying time, hours	Bentonite	Borate
1	Complete stop	Complete stop
2	Complete stop	Complete stop
3	Retarded	Complete stop
4	Burned through	Retarded

Brush pile tests.—Bentonite was compared with borate on brush piles composed of chamise stems that had been cut from a firebreak and dried for nearly 3 years. The tests were conducted in September. Air temperature varied from 85°F. to 89°F. during the burning tests; relative humidity, from 18 to 14 percent. Winds were gusty and variable, averaging about 6-8 miles per hour. Again the retardant dried 1, 2, 3, and 4 hours before burning.

The dry, flashy fuels produced hot fires in all piles (Fig. 4). The gusty, variable wind made burning conditions unlike in some of the tests; the wind drove the flames directly into the treated part of the brush piles treated with bentonite 1 and 3 hours earlier. In all other piles the flames backed against the wind into the treated area. Radiometer measurements indicated that the pile treated with bentonite and dried 3 hours produced by far the hottest fire.

No fires were completely stopped as in the grass plot tests, but all were retarded to some degree. Judging from the observed reduction in flame height and spread (Fig. 5) and from study of radiometer measurements, the retarding effect was rated as follows:

Drying time, hours	Bentonite	Borate
1	Fair	Very good
2	Good	Very good
3	Fair	Good
4	Good	Good

Tests on wildfires.—The criterion by which any new forest fire retardant should be judged is, of course, its effectiveness on wildfires after being applied in the normal manner. For this reason bentonite slurry was dropped by air tankers on wildfires in a variety of vegetation types, topography, and weather conditions. To obtain this broad testing area it was decided to use bentonite in both northern and southern California with the bases of operation separated by some 500 miles. The tests were made from airports where air tankers could make drops of both bentonite and borate on the same fire under similar burning conditions. Because of the limited mixing and storing facilities of the bentonite testing operation at each location, more drops of borate than bentonite were made on most fires.

One 120-gallon Stearman air tanker and one 180-gallon N3N air tanker operated out of the airport used in northern California. On each initial attack bentonite was dropped by one air tanker, borate by the other. The tanker carrying bentonite was alternated on each successive fire. Twelve loads of bentonite were dropped on 8 fires, including 4 in mixed brush, 3 in grass, and 1 in light slash of redwood and Douglas-fir.

The effectiveness of the drops, all of which were made immediately ahead of the fire line, was closely observed and photographed. The fires sometimes outflanked a drop of bentonite, but did not burn through. On these same fires most of the borate drops were effective although a few drops were noted to be ineffective on one fire.

From the southern California airport, 14 drops of bentonite were made on 4 brush fires by 4 different TBM air tankers each carrying 600 gallons of retardant. Borate was dropped on the same fires by other air tankers (Fig. 6).

Again, all observed drops showed bentonite was an effective fire retardant. A few of the drops on the 14,000-acre Monrovia Fire were flanked by the fire, but in no observed case did the fire burn through the bentonite soon after it had been dropped. Borate was also effective in most cases, although hot rolling flames on portions of the highly intensive Monrovia Fire burned through some drops and flanked others.

Drop patterns.—To compare the drop patterns of bentonite and

FIG. 2.—Flames averaged 10-15 feet in height in grass plots on which bentonite and borate were compared.

FIG. 3.—This strip of grass, sprayed with bentonite slurry, stopped the test fire abruptly after the slurry had dried for 2 hours.

FIG. 4.—Dry, flashy chamise fuel produced flames averaging 15-20 feet in height on all brush piles.

FIG. 5.—Flame height was lower (and forward spread slowed) in brush treated with either bentonite and borate than in untreated brush.

borate, the slurries were dropped into a stand of mixed brush and pine saplings with a crown canopy density of 70 percent and an average height of 5 feet. The average air temperature was 74°F., relative humidity 20 percent, and winds 3 miles per hour from the northwest. Conditions varied only slightly during the morning test period. Two air tankers made one drop each of bentonite and borate, the four drops being approximately parallel to each other and all confined within a 2-acre area.

Observations and photographs showed that there was no apparent difference between bentonite and borate in the following characteristics:

1. Dispersion in the air as the slurries left the air tankers.

2. Drop patterns on the ground.

3. Ability to penetrate the vegetative canopy—both retardants coated the ground litter immediately around the base of the stems of manzanita and scrub oak.

4. Manner of coating the vegetation—both retardants set up on globules on the needles of pine trees and on the new, waxy leaves of manzanita; both made continuous coats on the older leaves of manzanita and all leaves of scrub oak, coating both sides of some leaves.

Drying characteristics of the two retardants were also observed. After 30 minutes all but a few heavy concentrations of the borate located in deep shade had dried. This same condition was reached by the bentonite after 90 minutes. The dried borate left a relatively thick coating on the vegetation; the dried bentonite made a relatively thin coating owing to the smaller amount of dry material in the slurry.

Need for coloring.—Pilots at Hobergs Airport who first made drops of bentonite from air tankers discovered in looking back that they could not see where their drops had been made. In tests of materials to make bentonite slurry more visible from the air, pink aniline dye was found to be the best general purpose coloring. Yellow dye was best for green vegetation but did not show well on dry grass. Deep shades of red were good on dry grass but did not show well on dark green vegetation. White pigments, such as titanium dioxide and calcite, did not mix well with the bentonite slurry, and the addition of large amounts (up to 25 percent by weight) did not effectively change the color of the slurry. Rhodamine B 500 percent concentrate, pink aniline dye, was found to be good on all vegetative types and is recommended as the best color compromise.

FIG. 6.—Air tankers dropping borate and bentonite were used extensively to help control the high intensity Monrovia Fire.

Discussion

Fire retardants have now been used successfully in air tankers for 3 years. The 1958 tests of swelling

bentonite clay showed that it is a good forest fire retardant for 2 to 3 hours under summer drying conditions. Bentonite, as compared with sodium calcium borate, demonstrated several desirable characteristics:

1. Sets up into a stable, viscous gel, becoming fluid upon agitation and being kept fluid by the addition of certain inexpensive chemicals (*8*, *10*).

2. Is relatively cheap, being one-twelfth the cost of borate in California and giving an even better cost advantage in other areas.

3. Is readily available in many locations.

4. Is relatively nonabrasive in pumps.

5. Is nontoxic to plants and animals.

6. Does not compact under prolonged storage.

7. Is noncorrosive to metals used in mixing, storing, and pumping equipment.

8. Requires considerably less warehousing and handling because its mixing ratio with water is one-fifth that of borate.

Bentonite also showed disadvantages when compared with borate:

1. Is effective as a retardant for only 2 to 3 hours, depending on the fuel, volume of the drop, and drying conditions. Therefore bentonite should not be relied upon for pretreatment for longer periods.

2. Should have color added, especially on large fires where many drops are required.

3. Viscosity must be controlled.

4. Transfer hose lines must be flushed occasionally.

5. Hard water will tend to reduce the water-holding capacity of bentonite. It must be controlled by use of water-softening agents.

The tests with bentonite suggested several possibilities for further studies of the material as a fire retardant. Other commercial grades of bentonite may be easier to handle with improved mixing equipment. Perhaps the water in the bentonite slurry can be held for longer periods by adding evaporation inhibitors, viscosity agents, or foaming agents. A residual effect may be created by adding flame-inhibiting agents to the water used to mix the bentonite slurry. Exploration of these and other possibilities may help develop a better fire retardant.

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Richard Thornton Fisher Fellowships In Forest Science, Harvard University

Two fellowships, each with a fixed stipend of $2,200, are offered to qualified applicants intent upon proceeding for a master degree in Forest Science (M.F.S.) in the Graduate School of Arts and Sciences, Harvard University. These fellowships are designed to encourage students to undertake further training and research in the following aspects of forest science: forest ecology; silviculture; forest tree physiology; forest soils; and forest economics.

To qualify for entry, a candidate must hold a bachelor degree in forestry, or a bachelor degree with a major in biology, economics or soil science. Successful candidates will be expected to spend 15 months at the Harvard Forest in Petersham, Mass., or at the Harvard Black Rock Forest, Cornwall-on-Hudson, N. Y., and to write an acceptable thesis based on original research.

Apart from the accumulated experience of 50 years' research on its native woodlands, the Harvard Forest has 300 acres of experimental plantations, a forestry library containing more than 10,000 volumes, and laboratory facilities. Close cooperation is maintained with the Department of Biology, as well as with other departments of the University in Cambridge, Mass., whose research and training programs impinge upon forestry. Housing accommodation for single and married students is available at nominal cost.

Applications for matriculation at the beginning of the Summer School (July 1961) must be completed and filed with the Graduate School of Arts and Sciences, 471 Broadway, Cambridge 38, Mass., by February 1, 1961. Further information, together with application blanks for financial aid, may be obtained from the Graduate School.

Professional Income of Foresters—1959

F. H. Eyre

BY ACTION taken at its May 1959 meeting, the Council of the Society of American Foresters authorized the appointment of a committee to explore the possibilities of a survey of professional income of foresters. Such a committee[1] was appointed by President George A. Garratt and asked to report to the Council at the time of its annual meeting in November 1959. The committee recommended, and the Council approved, that a survey of 1959 professional income be undertaken during 1960 by means of an anonymous questionnaire to be sent to the entire membership except Student Members and Associate Members. It was the belief that income information, thus obtained, would be useful to individual foresters in measuring their rate of progress in the profession, to counselors in advising prospective foresters on income possibilities, and to employers in their programs of recruitment.

A two-page questionnaire[2] was devised and mailed to all Junior Members, Affiliate Members, Members, and Fellows. The form was to be *unsigned*.

TABLE 1.—MEDIAN PROFESSIONAL INCOME BY YEARS OF EXPERIENCE FOR ALL TYPES OF EMPLOYMENT COMBINED

Years of experience	Number reporting	Income (in dollars)		
		Median	Upper decile	Lower decile
0 — 1	532	4,800	5,890	4,110
2 — 5	1,552	5,710	7,000	4,720
6 — 10	1,825	7,010	8,920	5,580
11 — 15	1,203	7,970	11,500	6,230
16 — 20	588	8,900	14,630	6,460
21 — 25	694	9,490	15,520	7,120
26 — 30	632	9,750	14,960	7,170
31 — 35	287	10,370	16,070	6,930
36 +	178	12,080	21,460	7,400
Total	7,491[1]			
Overall median and deciles		7,310	11,610	5,110

[1]In addition there were 30 unusable returns making a total of 7,521.

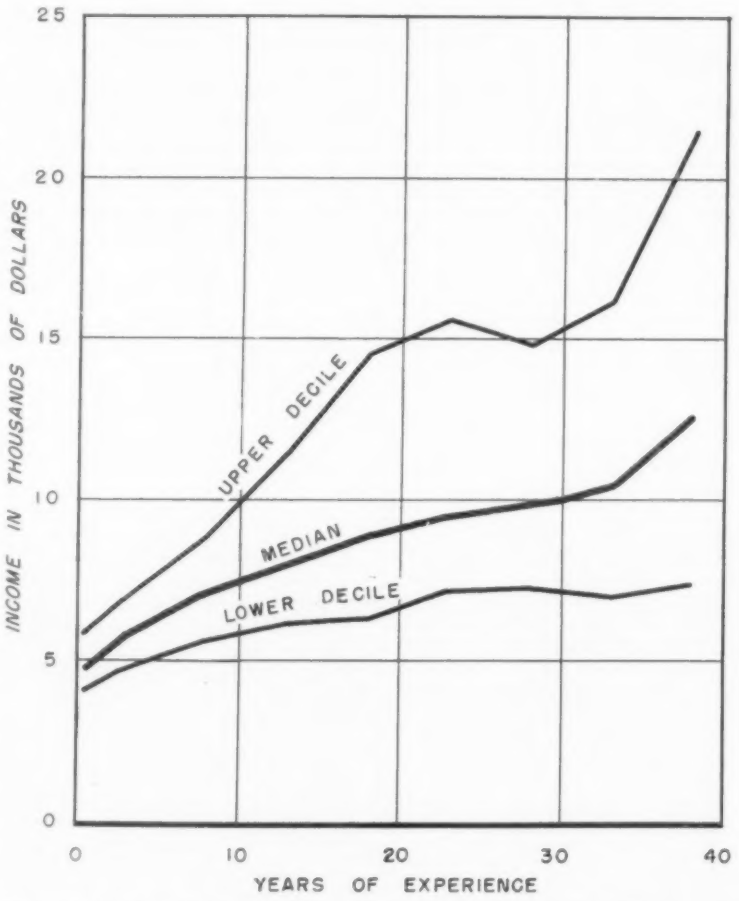

FIG. 1.—Median income compared with upper and lower deciles by years of experience.

THE AUTHOR is staff editor of *Forest Science*, Society of American Foresters.

[1]The committee consists of Paul M. Dunn, director of forestry, St. Regis Paper Company, New York, N. Y., *chairman*; Ralph D. Hodges, Jr., director, Forestry and Economics Division, National Lumber Manufacturers Association, Washington, D. C.; Chalmer K. Lyman, director, Division of Personnel Management, U. S. Forest Service, Washington, D. C.; Wilbur W. Ward, resident director, Mont Alto Branch, The Pennsylvania State University, Mont Alto, Pa.; and Francis H. Eyre, Society of American Foresters, Washington, D. C., *secretary*.

[2]The committee acknowledges with gratitude the help provided by Leonard M. Butrym and William F. Hice of the U. S. Forest Service in adapting the form to fit IBM tabulation; also that of A. A. Hasel in advising on the analysis.

TABLE 2.—MEDIAN PROFESSIONAL INCOME BY EDUCATIONAL ATTAINMENT AND YEARS OF EXPERIENCE

Years of experience	Median income (in dollars)				Total returns
	Doctor	Master	Bachelor	Ranger school or high school	
0 — 1	[1] (2)[2]	5,150(70)	4,760(454)	[1] (1)	527
2 — 5	7,500(20)	5,930(285)	5,660(1199)	[1] (4)	1,508
6 — 10	7,980(53)	7,140(342)	6,940(1370)	6,250(23)	1,788
11 — 15	9,130(77)	8,270(249)	7,850(806)	7,120(39)	1,171
16 — 20	10,230(35)	9,120(133)	8,690(371)	7,230(29)	568
21 — 25	10,670(44)	9,170(147)	9,340(441)	7,710(41)	673
26 — 30	11,700(41)	10,170(137)	9,440(387)	7,780(42)	607
31 — 35	11,750(29)	10,540(84)	10,210(137)	9,500(26)	276
36 +	13,330(16)	11,330(48)	12,500(86)	9,900(15)	165
Overall median	9,710(317)	7,770(1495)	7,030(5251)	7,430(220)	7,283
Not classified or otherwise unusable					238
				Total	7,521

[1]Too few returns to calculate medians.
[2]Numerals in parentheses indicate number of returns.

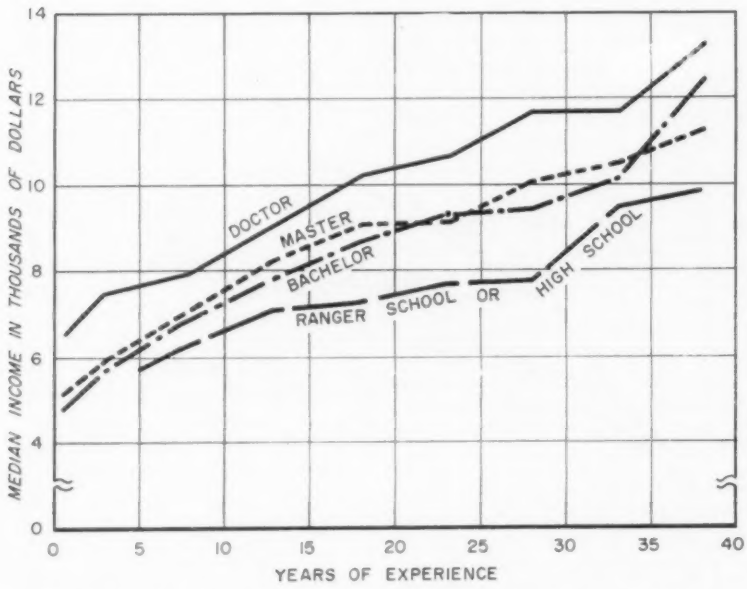

FIG. 2.—Median income by years of experience and educational attainment.

This constitutes the first comprehensive survey of professional income by the SAF. The last previous published effort by the SAF to compile general data on salaries was tabulated in the JOURNAL OF FORESTRY in July 1953. Since that survey was on a different basis and much less comprehensive, no attempt will be made to compare 1953 results with the 1960 survey of 1959 income.

In February 1960, 11,247 forms were mailed out. A return date of April 15 was indicated to agree with income tax time when employees have their financial records at hand. Some 7,812 (69 percent) of the forms were returned. This response was excellent, but not to compare with that of the Canadians who had an 89 percent return in their most recent forestry income survey.[3]

Of the 7,812 returns 203 were insufficiently filled out, were too late, or for some other reason were wholly unusable. All the rest were used to some degree. A return that was incomplete in one category may have been usable for the others. For example, when it was not possible for a respondent to specify that he practices primarily in one region or at one type of work he may have marked several. Such a return of necessity could not be used for the particular categories, but other information included in the form was used. Fortunately, in most cases sufficient members could specify a single region or a single type of work to provide reasonably ample data.

In addition to the 203 wholly unusable forms there were 88 retirees who reported. Since these were mostly part-time workers they were not included in the general tabulations but were analyzed separately. (Returns from other part-time workers were also excluded.) That left 7,521 returns for the main analysis.

The presentation of data is made on the basis of median income, but for categories containing less than 15 returns the median was not calculated.

Median Income Compared with Upper and Lower Deciles

Median income is a meaningful figure to describe in general the professional income of foresters. It is shown by years of experience in Table 1 and Figure 1. In considering the overall median of $7,310 one should realize that this figure is heavily weighted by those in experience brackets from 2 to 15 years. The graph, however, shows a steady increase and the peak is not reached until near the end of a career. The upper and lower deciles give an indication of spread. As used here upper decile is the value located so that 10 percent of the items fall above it and 90 percent below it. Lower decile refers similarly to the lower 10 percent.

Much has been said about the income of engineers. In comparison foresters do not fare well. The median income of engineers in 1958 (all activities combined)[4] was consistently $1,000 to $1,500 higher

[3]Babcock, H. M. Canadian Institute of Forestry Salary Survey—1959. 7 pp. mimeographed.

[4]Professional Income of Engineers—1958. Engineering Manpower Commission. EJC Report No. 112, 63 pp. 1959.

than foresters. Strangely enough, however, our data show that foresters exceed engineers in income after 35 years of experience.

Income and Education

Education pays. At least that is what our survey indicates (Table 2, Fig. 2). Those with doctor degrees receive the most income throughout their careers. Those with master degrees start out with slightly higher income than those with bachelor degrees. After 20 years of experience, however, the line in the graph crosses back and forth, and those with the bachelor degree finally emerge ahead in our analysis. A reasonable conclusion may be that the salary difference between foresters with bachelor and master degrees is not great, but that holders of doctor degrees consistently receive more income. Ranger school and high school graduates enter the Society through the experience route. When their income is plotted by years of experience (Fig. 2) it shows that they receive less than graduates as might be expected. But the overall median for this group is actually higher than for bachelors. This may be explained by the fact that few ranger school men in the first two experience brackets are included in our tabulation as they do not normally become members until they have had more experience. Those with bachelor degrees, on the other hand, are heavily represented in these brackets.

An attempt was made to relate the major course of study and professional income, but it was unsuccessful. Nearly 90 percent of those who marked this section of the form indicated the category of *general forestry* which included forest management and silviculture, leaving too few cases in the other groups for a good analysis. There is an indication that the specialties command higher salaries than general forestry, but this condition could be in part a reflection of more advanced training. The relatively few returns for pulp and paper technology and for forest products and wood technology indicate that these specialties, as identified by special school training, are not well represented among SAF membership.

TABLE 3.—MEDIAN PROFESSIONAL INCOME BY REGIONS

Region	Median income (in dollars)
Northeast	7,140(500)[1]
Middle Atlantic	7,010(534)
Southeast	7,060(1080)
South	7,020(1105)
Central States	7,370(381)
Lake States	7,350(680)
Great Plains	6,720(75)
Rocky Mountains	7,330(814)
Pacific Northwest	7,110(1353)
California	7,700(613)
Alaska, Hawaii, Puerto Rico, foreign	9,880(134)
Dist. of Columbia	11,300(158)
Forms not usable	(94)
Total returns	(7521)

[1]Numerals in parentheses indicate number of returns.

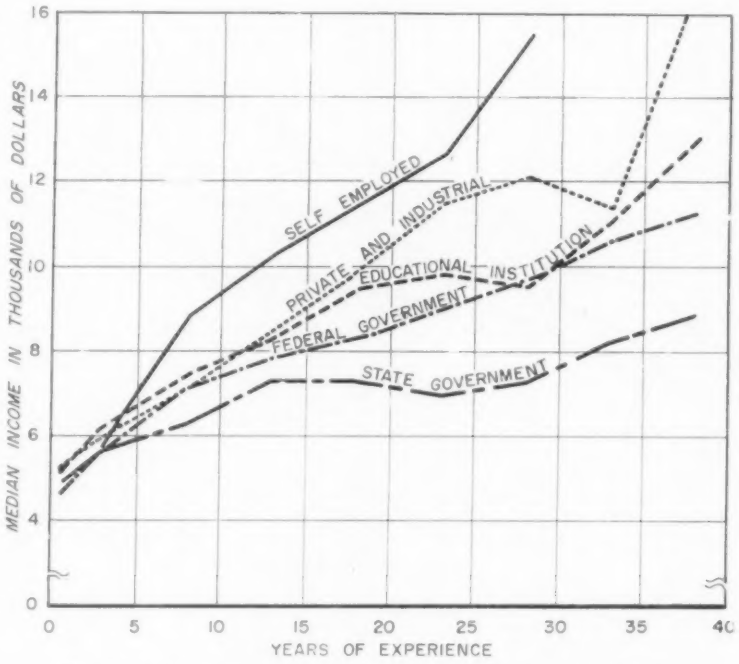

FIG. 3.—Median income by years of experience and class of employer.

Income by Regions

A young forester may wonder what part of the country to settle in to get the best income. A perusal of Table 3 will not help him decide; indeed, it shows that income in various regions is remarkably uniform. The District of Columbia, which is a special case for obvious reasons, is out of line; as is also the inclusive group comprising Alaska, Hawaii, Puerto Rico and "foreign" where usually a 25 percent salary increase is allowed. When income is reduced by 25 percent these overseas jobs pay about the same as those in other areas.

Actually, income in California is the highest, but is not greatly out of line; and the Great Plains show the lowest. In the latter region forestry is restricted in scope and there are evidently fewer good jobs.

One hears a great deal about industry moving to the South to take advantage of lower wages. There is nothing in our study to indicate that this implication carries over into professional forestry positions.

In the course of "editing," the forms returned by Canadian members of the SAF were excluded in view of the fact that they represented a different economic situation. It may be of some interest, however, that 33 Canadians with a median income of $9,375 returned the questionnaire. This income is considerably above the median of $6,800 given in Bab-

TABLE 4.—MEDIAN PROFESSIONAL INCOME IN DOLLARS BY YEARS OF EXPERIENCE AND CLASS OF EMPLOYER

Years of experience	Class of employer						
	Self-employed	Association or foundation	Educational institution	Private or industrial	Federal gov't.[3]	County or mun. gov't.	State gov't.[4]
0 — 1	[1] (3)[2]	[1] (4)	5,120(17)	5,310(145)	4,620(267)	[1] (4)	4,820(90)
2 — 5	5,790(19)	[1] (13)	6,210(49)	5,990(447)	5,650(715)	[1] (10)	5,690(288)
6 — 10	8,830(40)	7,670(16)	7,460(94)	7,160(816)	7,160(548)	6,070(17)	6,280(282)
11 — 15	10,310(62)	9,250(17)	8,330(98)	8,460(449)	7,830(345)	[1] (14)	7,290(208)
16 — 20	11,500(44)	[1] (9)	9,500(53)	9,980(211)	8,380(166)	[1] (4)	7,310(97)
21 — 25	12,910(39)	[1] (11)	9,820(59)	11,560(187)	9,000(303)	[1] (5)	7,000(86)
26 — 30	15,500(17)	[1] (10)	9,580(47)	12,180(100)	9,700(380)	[1] (4)	7,340(65)
31 — 35	[1] (7)	[1] (8)	11,170(29)	11,400(44)	10,630(144)	[1] (3)	8,290(50)
36 +	[1] (14)	[1] (4)	13,070(30)	16,860(45)	11,360(60)	[1] (2)	8,870(19)
Median	11,400(245)	9,210(92)	8,470(476)	7,460(2444)	7,300(2928)	6,690(63)	6,360(1185)
Upper decile	21,280	15,940	13,490	13,920	11,020	10,480	8,920

[1]Too few returns to calculate median.
[2]Numerals in parentheses represent number of returns. The number of returns used in this tabulation was 7,433, which with the 88 unusable returns made a total of 7,521.
[3]Attention is called to the fact that all federal workers received an increase of 7½ percent, effective in July 1960.
[4]A compilation issued by the Association of State Foresters under date of October 8, 1959 shows for all states the beginning and top rates of pay for professional foresters in state employ.

cock's report[5] for the Canadian Institute of Forestry.

[5]Op. cit.

Income by Class of Employer

In the compilation of income by class of employer it is not unexpected to find the self-employed forester in first place (Table 4, Fig. 3). It may be argued that he deserves such a rank because he takes the biggest risks. But it does come as a distinct surprise that educational institutions' pay substantially more than the federal government. Educational institutions probably employ a greater proportion of foresters holding advanced degrees so the effect of more training as shown in Figure 2 may be reflected in the median.

Unfortunately, there were too few returns to permit calculation of median income by years of experience for those working for associations and foundations, and for county and municipal governments. However, the overall median has been computed for these and other groups (Table 4). The order of the ranking for the median for all groups is: (1) self-empoyed, (2) association or foundation, (3) educational institution, (4) private or industrial, (5) federal government, (6) county or municipal government, and (7) state government.

A comparison of the overall median of the private and industrial group ($7,460) with the federal government ($7,300) is of interest. One would expect a greater difference after examining the graph (Fig. 3). Contributing to the closeness of the medians is the fact that there are in our tabulation more federal positions not in the top brackets but still paying fairly well than in the private and industrial group.

The divergence in salary between groups with increasing experience is also enlightening (Fig. 3). All start out at nearly the same level, but the spread becames greater with the years.

Of particular interest is the calculation of the upper decile (Table 4). For the various groups the upper decile was: (1) self-employed $21,280; (2) association or foundation $15,940; (3) private or industrial $13,920; (4) educational institution $13,490; (5) federal government $11,020; (6) county or municipal government $10,480; and (7) state government $8,920. It should be pointed out that for open-end salary brackets, such as $20,000 and over, the same salary interval as that shown immediately below in the form was used for the computation. Actually it is higher, but just how high cannot be determined.

TABLE 5.—MEDIAN PROFESSIONAL INCOME BY TYPE OF WORK

Type of work	Median income (in dollars)
Technical sales and service	10,460(90)[1]
Association, technical writing, publicity, editorial	9,160(108)
Teaching	8,720(309)
Production and operation	8,560(369)
Consulting	8,330(238)
Research and development	7,650(815)
Timber and wood procurement	7,570(375)
Protection specialist	7,350(228)
Forest administration	6,900(4042)
Nursery work	6,800(84)
Usable returns	(6658)

[1]Numerals in parentheses indicate number of returns. There were 863 unusable returns which, together with the 6,658 usable ones, made a total of 7,521.

Type of Work and Specialization

An effort was made to relate type of work to income. This plan was only partially successful because it was difficult for many persons to designate a single type of work. The result was that several types were marked or the category *forest administration* was indicated. The latter became a catchall with 60 percent of forms being so marked. In consequence, the other kinds of work were not represented as well as was hoped. Nevertheless, Table 5 does present some interesting information.

The category of "primary field of work specialization" was set up in the questionnaire in the hope that some further pinpointing of income by kind of work would be possible. As in the case of "type of work," this plan was not wholly successful. It shows, however, that the field of utilization is most remunerative, and with 533 returns the figure should be reliable (Table 6).

SURVEY OF PROFESSIONAL INCOME — 1959
SOCIETY OF AMERICAN FORESTERS

Society of American Foresters, Mills Building, 17th Street and Pennsylvania Avenue, N.W., Washington 6, D. C.

A. EXPERIENCE AND EDUCATION:

B. REGION WHERE CURRENTLY EMPLOYED:

C. EMPLOYER (main source of income only):

D. TYPE OF WORK (indicate principal type only):

E. PRIMARY FIELD OF WORK SPECIALIZATION (indicate one only):

F. PROFESSIONAL INCOME (excluding any annuities):

FIG. 4.—Form used in survey.

Income of Retirees

One question in the return was designed to get a record of foresters retired on an annuity who are still able to earn additional income through professional employment. A total of 88 retired persons indicated that they had professional income; it ranged from below $3,000 (the greatest number) to over $20,000. The median was $5,778.

How Representative is the Study?

As previously mentioned, the survey was confined to SAF members (exclusive of Student and Associate Members). To the extent that the 69 percent return from this membership represents the profession at large, the figures on income should be reliable. It seems likely, however, that certain types of work; such as forest products, wildlife management, and range management, are not well represented in our study. These specialties have their own separate societies.

Future Surveys of Income

Should surveys of professional income be conducted periodically? In recent years the Canadian Institute of Forestry has conducted an annual survey of professional income. The Engineering Manpower Commission does so every two years. This interval would seem too often for the needs of the forestry profession, but a survey every 3 or 4 years might be useful.

TABLE 6.—MEDIAN INCOME BY PRIMARY FIELD OF SPECIALIZATION

Specialization	Median income (in dollars)
Utilization of forest and wood products	8,990(533)[1]
Forest economics	8,440(184)
Forest pathology	8,180(60)
Forest range management	8,120(100)
Forest engineering (logging, road construction)	7,890(327)
Generalist	7,870(747)
Forest recreation	7,720(176)
Forest entomology	7,570(70)
Forest wildlife management	7,500(64)
Watershed	7,480(141)
Forest fire protection	7,480(286)
Forest management and silviculture	6,800(3818)
Scaling and grading	6,790(54)
Photointerpretation, timber inventory	6,170(250)
Usable returns	(6810)

[1]Numerals in parentheses indicate number of returns. There were 711 unusable returns which, together with the 6,810 usable ones, made a total of 7,521.

If such a survey is undertaken in the future several revisions and improvements could be made in the design of the questionnaire (Fig. 4). In particular the form could be streamlined to advantage. Since nothing much came of the question about "course of study," that category could be dropped. It should not be necessary to repeat on the question of income of retirees. Careful study should be made to sharpen up the questions on type of work and specialization. And spots should be provided for the extension forester, the farm forester, the personnel manager, and certain others who had no appropriate place to indicate their specialties on the present form. Information on supplementary income requested in the present study, but not analyzed separately, could well be retained as many foresters maintain a side line.

Comparative Development of Seeded and Planted Shortleaf Pine On A Forest Site in the Missouri Ozarks

Robert E. Phares and Franklin G. Liming

LOW-GRADE oak stands in the Missouri Ozarks can be made more productive by introducing shortleaf pine. Where pine seed trees are not available for natural regeneration, artificial regeneration is necessary. If shortleaf pine could be established successfully by direct seeding, composition of many low-grade oak stands could be improved much more economically than by planting. So, as part of a study to test the feasibility of direct seeding, we compared stocking and growth of 1-year-old seedlings established by direct seeding with stocking and growth of planted 1-0 seedlings.

The Study

The study was begun in 1941 on the Mark Twain National Forest. The site supported a low-grade, pole-size oak stand typical of those commonly being converted to shortleaf pine (Fig. 1). The soil is Clarksville stony loam. Blackjack oak (*Quercus marilandica* Muenchh.) and post oak (*Quercus stellata Wangenh.*) were the predominant species. The overstory contained 300 to 400 trees per acre, ranging from 4 to 6 inches in diameter and 25 to 40 years in age. The understory consisted of about 1,500 trees per acre, most of which were 3-to-5-year-old sprouts.

Six 1/10-acre plots, each surrounded by a half-chain isolation strip, were used in the study. The overstory trees were removed by clearcutting on three of the plots and by girdling on the other three. In April 1941, spots spaced 6.6 by 6.0 feet were cleared of the 1-to-2-inch litter layer, cultivated to a depth of about 2 inches, and seeded at the rate of about 10 filled seeds per spot.

Rainfall and temperature during the first growing season after seeding were about average for the region. However, seedlings still failed to become established on about 70 percent of the spots. The poor catch was attributed to the late seeding date, because in another study we found fall seedings to be much more successful than spring seedings.[1] There was nothing to indicate that the spots with seedlings were any more favorable for pine survival and growth than those without seedlings.

In April, 1942, one year after the field seeding, 1-0 nursery-grown shortleaf pine seedlings from the same general seed source as the field-sown seed were planted in all of the vacant seed spots. Hence, *both seeded and planted trees were 1 year old when stocking and height growth comparisons of the two types of seedlings were begun.*

Changes in stocking were expressed as a percent of the total number of seeded and planted spots stocked in the spring of 1942 (1 year after seeding and at the time of planting). A spot was considered to be stocked as long as it contained at least one living seedling. About 40 percent of the spots stocked with seeded pine had

[1] Phares, Robert E., and Franklin G. Liming. The effects of month of seeding and methods of overstory release on development of direct seeded shortleaf pine on Missouri Ozark forest sites. Unpublished manuscript.

THE AUTHORS are, respectively, research forester and former research center leader, Central States Forest Expt. Sta., Columbia Research Center, Forest Service, U. S. Dept. Agric., Columbia, Mo., maintained in cooperation with the University of Missouri Agric. Expt. Sta. Mr. Liming has subsequently transferred to Washington, D. C.

FIG. 1.—The blackjack-post oak stand on the study area had little value. Such sites will support good shortleaf pine stands but since there is no natural seed source, pine must be established artificially.

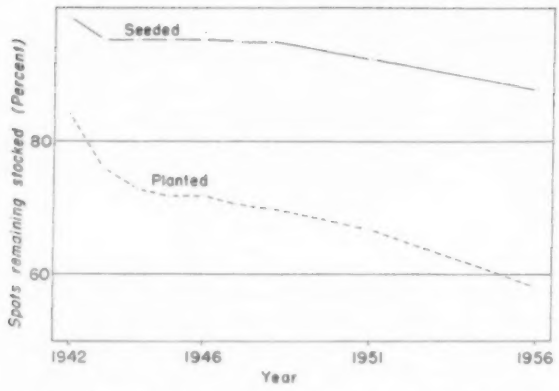

FIG. 2.—Percent of seeded and planted spots remaining stocked at the end of various growing seasons. (Based on the spots stocked in the spring of 1942.)

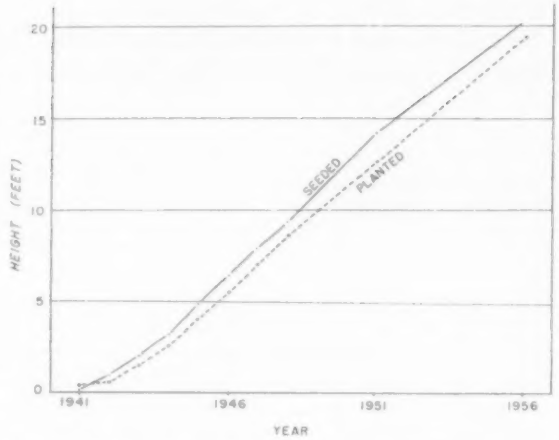

FIG. 3.—Periodic changes in average height of shortleaf pine trees established by direct seeding and by planting.

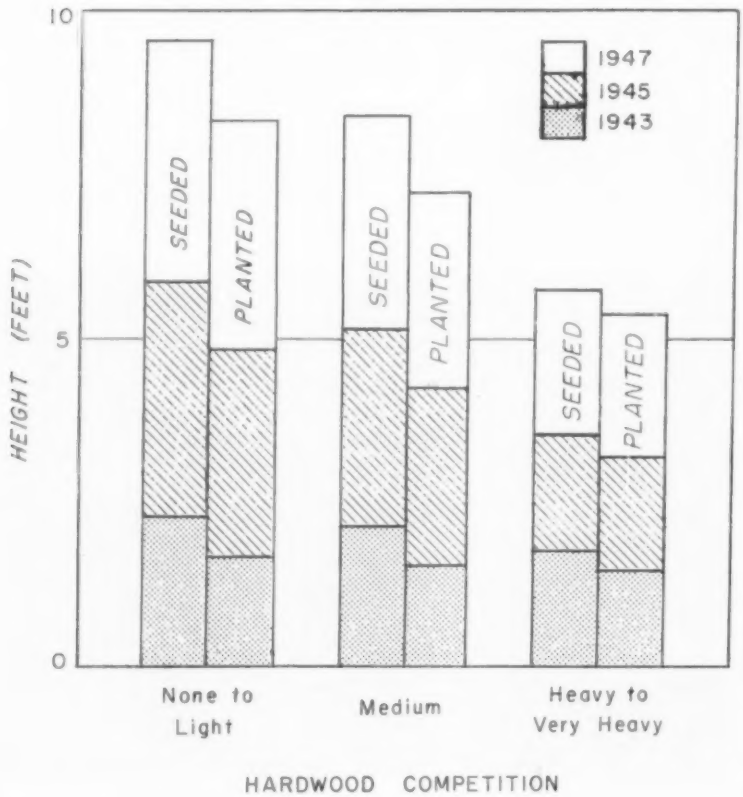

FIG. 4.—Average height of seeded and planted shortleaf pine trees under various levels of hardwood competition.

more than one seedling. Height of the tallest seedling in each spot was measured. Except for the first measurement (spring of 1942) heights were measured at the end of the growing season.

Development of seeded and planted pine was essentially the same for the two methods of removing the overstory, so the data for the two methods are combined.

Results

At the end of the 1942 growing season a greater percentage of the seeded spots remained stocked than of the planted spots (Fig. 2). Subsequent mortality throughout the study period also was less for the seeded spots than for the planted spots. Most losses of stocked seeded and planted spots during the study period, however, occurred in 1942 and 1943. By 1956, 88 percent of the seeded spots and only 58 percent of the planted spots remained stocked.

At the time of planting, the average height of the nursery-grown seedlings was greater than that of the field-grown seedlings (Fig. 3). In just one growing season (1942), however, the seeded trees had outgrown the planted trees. By the end of the fifth growing season the difference in height had increased to almost one foot and remained rather constant through 1956.

Competition from hardwood re-

production influenced height growth of both seeded and planted pine—the more competition, the slower the trees grew (Fig. 4). Intense competition retarded the height growth of seeded trees more than that of planted trees, but the seeded trees still remained taller. Comparisons were not made beyond 1947, because by that time the crowns had closed to the point where the pines were competing with each other as well as with hardwoods.

Discussion and Conclusions

The fact that the seeded trees survived and grew better than the planted trees may be due partially to their better establishment. Transplanting results in the loss of some roots during lifting and the crowding of roots during planting. These injuries often result in poor development of the planted trees. Another thing that may have helped the stocking and growth of seeded pine was the fact that many of the seeded spots had more than one seedling. When more than one seedling develops in a spot the chances are better that the spot will remain stocked and that one seedling will have a fast growth rate.

It is concluded from this study that if seedlings that develop from direct seedings can get by the critical first growing season, they will survive better and grow faster than planted seedlings of the same age on areas where overstory hardwoods have been removed. Since seeded pine outgrow planted pine under all degrees of hardwood competition, they have a slight advantage over planted pine in overcoming any competition that may develop.

Seed Production from Individual Cones of Grand Fir[1] (Abies grandis Lindl.)

Te May Ching

THE LOW germinability of true fir seed is a well known fact in the Pacific Northwest. This often produces variations in seed testing results, causes uneven nursery emergence, and irregular stocking after direct seeding. Little is understood about the cause of such poor viability. The present study was initiated to determine the variation in seed producing capacity among cones collected on the same location by a commercial cone collector. The nature of the variation might throw some light on the cause of the poor seed quality and indicate the means whereby improvement of quality might be realized.

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[1]Technical Paper Number 1302, Oregon Agric. Expt. Sta. Project was partly supported by the Bureau of Land Management, Department of Interior, and conducted in cooperation with the Forest Tree Seed Committee.

Materials and Methods

Approximately 50 sacks of grand fir (*Abies grandis* Lindl.) cones were collected on September 15, 1958 in the area of Three Sisters, Oregon, at an elevation of 5,000 feet by the Woodseed Company, Salem, Ore. After one month of storage in sacks in open sheds, two cones were randomly drawn from each of the 10 randomly selected sacks. Each of the 20 cones was measured, weighed, and put in individual cheesecloth bags to dry by progressive heat of 25—45°C for three and one-half days. At this stage the cones contained a uniform moisture content of 8 percent. The weight of the cones was taken again at the end of the drying period, and this is used as the cone-dry weight for convenience. The cones were then manually broken apart and the cone-scales were sifted out. The winged seeds were weighed and dewinged by hand and the light seeds were separated by a South Dakota blower for 30 seconds with a gate opening of 43, at which the residues contained more than 90 percent filled seeds and the blown out portions less than 3 percent filled, but extremely light seeds. The residue was designated as cleaned seed. The cleaned seeds were weighed and counted, after a stratification period of four weeks at 3—5°C, then incubated in a germinator with an alternating temperature of 20°C (16 hours daily in dark) and 30°C (8 hours daily with light). The germination medium was moist sand and the germination test was concluded at the

end of four weeks incubation, as no firm seeds remained ungerminated.

Results and Discussions

Table 1 summarizes the cone size, fresh weight, dry weight, moisture content, weight of total seeds, weight of cleaned seeds, number of cleaned seeds per cone, average seed weight, and germination percentages from cleaned seeds. The results indicated several interesting facts; the cone diameter was rather uniform as shown by the low coefficient of variation (6.58 percent) while the cone length varied from 7.5 cm. to 11.9 cm. as indicated by a coefficient of variation of 13.02 percent. The cone size is known to be different within the species of many coniferous trees (*2, 5, 6*). The variation probably is dependent upon the inherited characteristic of the tree, the location of the cone on a tree, and the nutritional status of the tree, thus the variation is not beyond expectation. The cone fresh weight also fluctuated greatly from 24 grams to 81 grams, the cone dry weight from 15 to 49 grams. The coefficients of variation for both cases were over 30 percent.

The moisture content of the cones, even after one month of storage in a uniform environment still varied from 25 percent to 56 percent and with a relatively large coefficient of variation (20.54 percent). The original moisture contents of the cones were undoubtedly more variable, and some of them might have had very high moisture content at the time of collection. Research data (*7, 8*) indicates that the moisture content decreases with cone maturity. The observed variation in moisture content clearly indicated the difference in maturity when the cones were collected. As the experimental material was collected on the same date and in one location, a difference in cone maturity is shown here within a small area and a short period of time. This kind of deviation in maturity among cones collected on the same date from different trees has been reported in Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) (*6*) and in longleaf pine (*Pinus palustris*) (*8*).

The total seed weight signified the combined effects of seed producing potential from individual cones (total number of seed), of number of fertilized seeds, and of seed weight. The genetic characteristics of the maternal trees and the variation in environmental factors such as nutrients, light, and water supply may also have contributed to the difference in total seed weight. The weight of cleaned seed from individual cones differed from 1.31 to 7.85 grams and with a very large coefficient of variation, 46.95 percent, and is significantly correlated with cone-dry weight ($r = .885$) and cone length ($r = .790$). This positive correlation between the size and weight of the cones and seed production was observed in Scotch pine (*P. sylvestris*) (*2, 9*). The average weight of cleaned seeds varied from 26 mg. to 48 mg. This would indicate that either the size of the seed is different in individual cones and/or the density of the seed varies owing to the nutritional status of the tree or to the maturity level of the cones. All of these phenomena have been observed in other conifers (*5, 6, 7*). The number of cleaned seeds per cone fluctuated from 43 to 188 and it was not correlated with cone length or cone dry weight. Since the total cleaned seed weight is correlated with cone size and weight, the nutritional supply probably governs the seed production, assuming the relative effectiveness of pol-

TABLE 1.—CONE SIZE, WEIGHT, MOISTURE CONTENT, SEED PRODUCTION, AND GERMINATION DATA FROM INDIVIDUAL CONES OF GRAND FIR

Cone no.	Cone size cm		Cone dry wt. gm.	Cone moisture %	Total seed wt. gm.	Cleaned seed			
	Diameter	Length				Total wt. gm.	No. seeds	Ave. seed wt. mg.	% germination
1	4.4	11.2	42	38	11	6.78	140	48	92
2	4.1	10.1	36	44	9	5.60	140	40	44
3	3.8	8.9	24	31	6	3.51	95	37	72
4	4.0	8.7	28	36	7	5.54	151	37	69
5	4.2	10.9	46	25	11	6.32	134	47	63
6	4.3	11.0	45	30	12	7.89	165	48	73
7	4.2	9.5	32	32	9	5.43	141	39	80
8	4.1	9.3	32	42	10	7.37	188	39	55
9	4.0	9.1	26	49	6	2.61	86	30	1
10	3.8	8.4	26	38	8	3.81	100	38	69
11	4.0	9.2	32	30	9	3.56	100	36	81
12	4.4	11.9	49	40	14	7.85	167	47	42
13	4.0	10.0	27	34	7	5.21	158	33	53
14	3.7	7.9	23	26	5	2.63	100	26	21
15	3.4	7.5	15	37	3	1.31	43	30	93
16	3.7	9.1	22	42	7	1.87	60	31	50
17	3.9	9.5	28	40	7	3.63	100	36	44
18	3.9	9.4	17	56	5	2.42	73	33	44
19	3.4	7.5	18	31	5	3.10	95	33	88
20	3.8	8.1	18	40	5	2.17	67	32	47
Mean	3.95±.26	9.36±1.22	29.30±10.00	37.05±7.61	7.80±2.80	4.43±2.08	115.15±40.25	37.00±6.45	59.05±23.66
C.V.%	6.58	13.02	34.12	20.54	35.89	46.95	34.95	17.43	40.07

lination is uniform for one stand.

The wide range of percent of germination in the seed from individual cones is not correlated with any one of the physical criteria investigated. The lowest was one percent and the highest was 93 percent. Seed with low germinability, that is, smaller than 50 percent, either was from cones containing rather high moisture content (larger than 40 percent) before extraction as the seed from cones numbers 2, 9, 12, 16, 17, 18 and 20, or was lightest in weight of filled seeds such as cone number 14. The high cone moisture content and the small seed weight both indicate immature condition. Immature or light seed usually is incapable of germination, slow in germination, or retarded in growth after germination (*1, 3, 4, 5, 10*). Moreover, seed with high moisture content is more subject to heat damage during kiln drying for seed extraction. All these factors probably contributed to the low germinability.

From the data obtained, one may conclude that the grand fir cone length, cone weight, cone moisture content, and seed production are considerably variable in cones collected on one date in one natural stand. The seed production is significantly correlated with the cone dry weight, and the cone length. The germinability of the seed to a larger extent is affected by seed cone maturity, and cone maturity level is not uniform within cones collected on one date.

A maturity study is needed to establish some practical index or indices for cone collectors to follow so that only mature cones will be gathered at one time, and several collections be conducted on one stand. If this practice could be followed, then a longer cone collecting season will be sustained, which is advantageous to the cone collector as well as to the seedsman. In addition to careful collection, good practice of cone handling and better cleaning methods probably will improve grand fir seed quality to a higher standard than the present one.

Summary

Twenty grand fir cones drawn from a lot of cones collected on September 15, 1958 in one natural stand in the Three Sisters, Oregon, area were individually dried, their seeds were separated manually and germinated after four weeks' stratification. The cone length, cone fresh and dry weight, cone moisture content, and seed production were found to be variable. Seed yield is significantly correlated with the cone dry weight and cone length. The germinability of the seed to a large extent is affected by seed cone maturity, and cone maturity level is not uniform within cones collected on one date.

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National Science Foundation Graduate and Postdoctoral Fellowships for 1961-1962

The National Academy of Sciences-National Research Council, Washington, D. C., has again been called upon to advise the National Science Foundation in the selection of candidates for the Foundation's program of graduate and postdoctoral fellowships. The Foundation plans to award approximately 1,200 graduate and 150 postdoctoral fellowships in these two programs during the 1961-1962 academic year.

Committees of outstanding scientists appointed by the Academy-Research Council will evaluate applications of all candidates; final selection will be made by the Foundation and awards announced on March 15, 1961.

These fellowships are open to citizens of the United States and applications are evaluated solely on the basis of ability. Fellowships may be applied to advanced study in the mathematical, physical, medical, biological, and engineering sciences, including anthropology, psychology (excluding clinical psychology), and the following social sciences: geography, mathematical economics, econometrics, demography, information and communication theory, experimental and quantitative sociology, and the history and philosophy of science. They are open to college seniors, graduate, and postdoctoral students, and others with equivalent training and experience.

All applicants for graduate (predoctoral) awards will be required to take the Graduate Record Examination designed to test scientific aptitude and achievement. This examination, administered by the Educational Testing Service, will be given on January 21, 1961, at designated centers throughout the United States and in certain foreign countries.

The annual stipends for graduate fellows are as follows: $1,800 for the first year; $2,000 for the intermediate year; and $2,200 for the terminal year. The annual stipend for postdoctoral fellows is $4,500. Limited allowances will also be provided to apply toward tuition, laboratory fees, and travel.

Further information and application materials may be obtained from the Fellowship Office, National Academy of Sciences-National Research Council, 2101 Constitution Avenue, N.W., Washington 25, D. C. The deadline for the receipt of applications for regular postdoctoral fellowships is December 19, 1960, and for graduate fellowships, January 6, 1961.

Natural Thinning of Ponderosa Pine in the Black Hills

Clifford A. Myers
and James L. Van Deusen

FREQUENT SEED crops and favorable moisture conditions produce dense stands of ponderosa pine (*Pinus ponderosa* Laws.) in the Black Hills of South Dakota and Wyoming. Heavy seed crops occur about every 4 years, with fair crops at more frequent intervals. More than half the average annual precipitation (18 to 27 inches) falls from May to September and is often adequate for seedling establishment. Conditions are so frequently favorable for natural regeneration that dense stands are found even in areas where precipitation is only 18 inches.

Even though mortality is heavy in dense stands, enough trees remain to cause stagnation. The slow growth of dense 50- and 62-year-old stands has been described elsewhere (*6*). Progress of natural thinning for 51 years on two plots differing greatly in original stand density is reported here. Results from two adjacent thinned plots indicate what can be expected from precommercial thinning.

THE AUTHORS are foresters, Rocky Mountain Forest and Range Expt. Sta., Forest Service, U. S. Dept. Agric., central headquarters at Fort Collins in cooperation with Colorado State University.

Research reported in this article was conducted by the station's research center at Rapid City, S. Dak., in cooperation with the South Dakota School of Mines and Technology.

Plot Descriptions

Four adjoining 1/10th-acre plots in an even-aged ponderosa pine stand near Nemo, S. Dak., provided a comparison of natural and precommercial thinnings (Table 1). Two unthinned plots were established in 1906, when the oldest trees were 12 years old and 2.2 to 3.5 feet tall. Those plots were denser than average but did not represent an unusual condition for the region. A third plot was thinned to 3,280 trees per acre (spacing 3.6 $\times$3.6 feet) in 1919, leaving trees 25 years old. The fourth plot was established in 1957 in an area thinned in 1934 when the stand was 40 years old. Since no evidence of dead trees could be found, the 379 trees per acre (spacing 10.7$\times$10.7 feet) tallied in 1957 was assumed to be the number left in 1934.

The plots are located near the base of an 8 to 17 percent southwest slope at an elevation of 4,900 feet. The soil is a residual sandy loam derived from shale. Average depth is 26 inches. Annual precipitation averages 22 inches, with about 60 percent falling during the growing season. Site index is typical of the central Black Hills, 55 feet at base age 100 years.

Results and Discussion

The number of trees on the naturally thinned plots has always been far greater than desirable stocking (Table 1). Even at age 12 the stands were so dense that growth was reduced.[1] Unthinned plot A had almost three times as many trees as unthinned plot B. Despite heavy stocking at age 12, the number of trees had increased on both plots by age 18. An initial density of 16,000 trees per acre increased by 16 percent, and a density of 46,310 trees increased by 21 percent in 7 years. The higher initial density and the greater increase in density occurred on plot A. This was probably because the plot was closer to the seed source and on a gentler slope than plot B.

Almost 22,000 trees per acre died on plot A between age 18 to age 25. Trees dying during that period included nearly all those less than 13 years old. Natural thinning has been heavy since age 25 on both plots, especially plot A, which now

[1]Conditions to age 25 are described in Bates, C. G. Effects of thinnings in Black Hills yellow pine, progress report for 1919. Rocky Mountain Forest and Range Expt. Sta. Unpublished. 1919.

TABLE 1.—DEVELOPMENT OF THINNED AND DENSE UNTHINNED STANDS OF PONDEROSA PINE[1]

Plot	Number of trees at age				Stands at age 63						
					Average height		Average d.b.h.				
	12	18	25	63	All trees	100 largest	All trees	100 largest	Pulpwood	Volume	Basal area
	Number				*Feet*		*Inches*		*Rough cords*	*Cubic feet*	*Square feet*
Unthinned A	46,310	56,140	34,480	5,827	20	29	2.5	4.0	0	2,027	205
Unthinned B	16,000	18,490	17,470	6,596	20	28	2.4	4.2	0.5	2,061	207
Thinned age 25	—	—	3,280	2,220	24	29	3.8	5.8	1.5	1,915	173
Thinned age 40	—	—	—	379	31	36	6.5	8.1	16.1	1,204	88

[1]All computations on an acre basis, including height and d.b.h. of 100 largest trees.

has fewer trees than plot B.

Periodic losses in numbers of trees were far greater than normal yield table (*3*) values for comparable ages but were still too small to reduce density enough for good growth (Table 2). Natural thinning was too slow to compensate for the large numbers of trees present at the beginning of the periods of measurement. Annual mortality rate from the 25th to the 63rd year averaged 19 trees per acre for each thousand trees in the stand at the beginning of the period. Mortality rates for comparable ages and periods from the yield table are equal to or greater than those of the unthinned plots. Therefore, each thousand trees of the unthinned plots was reduced at a rate no greater than normal despite initial stand densities that were far above normal. Similar rates of natural thinning occurred on two other young unthinned plots in the Black Hills (*6*).

The slow rate of natural thinning for at least 63 years reflects the poor expression of dominance in unthinned stands. Although an intolerant species (*1*), the young ponderosa pines showed little tendency to differentiate into dominant and subordinate crown classes. Most trees were similar in height, crown size, and vigor for most of their lives. By age 63, some of the more vigorous trees in plots A and B were beginning to extend slowly above the general level of the crown canopy. About 18 percent of the trees in the unthinned plots were dominants and codominants. But many of these were weak examples of their crown class. Height of the largest dominants averaged 28 feet; intermediates averaged 21 feet. There were enough dominants and codominants to make a well-stocked stand, but they appeared unable to overcome competition within a reasonable time unless precommercially thinned (Fig. 1).

Present management objectives of producing sawlogs in a 160-year rotation and posts and pulpwood from thinnings cannot be reached in stagnated stands. A first commercial thinning should be possible by age 63, but at the present growth rate, one cannot be made on the unthinned plots until about age 150. Similar results were obtained in unthinned 50- and 62-year-old stands with densities much lower than those of the plots described here (*6*). Precommercial thinnings are necessary in dense young stands to produce sawlogs in 160 years and to maximize the yield of posts and pulpwood.

Thinning to 3,280 trees per acre at age 25 plus subsequent loss of 1,060 trees through competition was little improvement over natural thinning. Despite 15 years' more time to grow after thinning, trees of this plot were little more than half as large in diameter as trees on the plot thinned at age 40. They were only 50 percent larger than those on the unthinned plots. This lightly thinned plot contained only 1.5 cords of pulpwood per acre at age 63. Diameter growth

TABLE 2.—PERIODIC LOSSES AND AVERAGE ANNUAL MORTALITY RATE IN DENSE STANDS OF PONDEROSA PINE IN THE BLACK HILLS COMPARED WITH A NORMAL YIELD TABLE

Period of record	Beginning of period		End of period		Periodic loss	Annual mortality rate per thousand trees
	Age	Trees/acre	Age	Trees/acre		
Years	*Years*	*Number*	*Years*	*Number*	*Number*	*Number*
			Black Hills[1]			
38	25	34,480	63	5,827	28,653	22
38	25	17,470	63	6,596	10,874	16
22	28	13,676	50	6,784	6,892	23
22	40	5,440	62	2,764	2,676	22
			Normal Yield Table, Site Index 50			
40	20	7,600	60	1,780	5,820	19
20	30	5,710	50	2,660	3,050	27
20	40	4,020	60	1,780	2,240	28

[1]First two plots described in this report, other two described in (*6*).

FIG. 1.—Unthinned plot A when 63 years old. There are 5,827 live trees per acre with an average d.b.h. of 2.5 inches. Growth on this plot is still stagnated.

FIG. 2.—Appearance at age 63 of the plot thinned to 379 trees per acre at age 40. Average d.b.h. of these trees is 6.5 inches. Note that relatively wide spacing did not result in the development of coarse limbs or bushy crowns.

averaged only 0.4 inch for the last decade. A second precommercial thinning is needed to eliminate stagnation and stimulate growth. None of the investment in the two precommercial thinnings could be recovered within 20 years.

In contrast, the more heavily thinned plot contained 14.6 cords more than the lightly thinned plot at age 63 although thinned 15 years later (Fig. 2). Part of the 14.6 cords can be harvested soon in a commercial thinning that will recover some of the precommercial thinning costs. The rest can be left to increase in size and value. Average diameter growth during the last decade was 1.0 inch or 2.5 times greater than on the lightly thinned plot.

Stagnated stands will respond to release with greatly increased growth until they are at least 40 years old, as demonstrated by thinning in 1934 when the stand was 40 years old and still stagnated. Similar results have been obtained in another 40-year-old stand in the Black Hills (*6*). Forty-year-old ponderosa pines in the Pacific Northwest responded well to release from a lodgepole pine overstory (*4*), and 46-year-old ponderosa pines increased their growth after thinning (*5*). Krauch (*2*) reported that dense ponderosa pine stands in the Southwest will respond to release even when mature. The maximum age at which Black Hills ponderosa pine will respond satisfactorily to thinning has not been established. Desirable age for precommercial thinning likewise has not been established, but may be about 15 years.

Conclusions and Summary

Four one-tenth acre plots in a 63-year-old ponderosa pine stand near Nemo, South Dakota, provided comparisons of the effectiveness of natural and precommercial thinnings. Two plots established when the trees were 12 years old had never been thinned. A third plot was thinned to 3,280 trees per acre at age 25 and the fourth was thinned to 379 trees per acre at age 40.

Natural thinning was not heavy enough to put the two untreated stands in productive condition. At age 63 the stands contained 5,827 and 6,596 trees per acre, which averaged about 2.5 inches d.b.h. In contrast, thinning to 379 trees per acre at age 40 resulted in trees averaging 6.5 inches d.b.h. and containing 16 cords of pulpwood per acre by age 63.

Several points that should be considered by forest managers in the Black Hills are indicated by the results from these and other similar plots.

1. Natural thinning occurs at too slow a rate to put dense stands of ponderosa pine in a productive condition within a reasonable length of time.

2. The slow rate of natural thinning reflects the poor expression of dominance in dense young stands.

3. Precommercial thinnings are necessary if dense young stands are to produce sawlogs in the established 160-year rotation along with maximum yields of posts and pulpwood.

4. Stagnated stands will respond to release until they are at least 40 years old. The maximum age has not been established for the Black Hills.

5. Very light thinning, such as to 3,280 trees per acre, is little improvement over natural thinning, even in stands of small saplings.

6. Density can increase considerably in heavily stocked seedling stands, even where there is more than one tree per square foot.

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Oregon to Supply 1960 Tree for Pageant of Peace

A 90-foot Douglas-fir from the forests of Oregon will be the center of attention when President Eisenhower lights the official tree for the Christmas Pageant of Peace this year in Washington, D. C.

The "perfect" tree, selected by State of Oregon foresters from a host of entries, was found on timberlands of the Georgia-Pacific Corporation near Springfield, Ore. Early in December it will be cut, carefully loaded on a railroad car, and shipped across the country to the White House. A few days before Christmas, one of the biggest tree-decorating jobs in the world will be undertaken by skilled workmen from the National Park Service.

When the final touches are complete, ceremonies headed by President Eisenhower will dedicate the tree and the Christmas Pageant of Peace to the hope of all mankind for peace in the world.

Notes and Observations

Fertilizer Helps Establish Grass Seedings on Abandoned Logging Roads

After a logging operation, abandoned truck roads should be "put to bed" to forestall excessive erosion. This is normally accomplished by such measures as installing water bars and removing shoulder berms and temporary bridges and culverts. In some cases, a quick cover of vegetation is also good insurance against excessive erosion.

To determine the feasibility of establishing vegetation on abandoned logging roads in the Douglas-fir region, a limited experiment was conducted in the western part of the Mount Hood National Forest, in the Cascade Range of Oregon. The road used in this experiment is located at an elevation of 2,500 feet on Olympic soils derived from basalt and andesitic rocks. It penetrates a dense, old-growth Douglas-fir stand and lies in almost perpetual shade. The climate is cool and humid; precipitation averages 110 inches per year.

The road was used during 1956-57 and had been abandoned for a year before the seeding experiment started. During this period some surface erosion occurred, and a large part of the fine soil particles was washed away (Fig. 1). In the spring of 1958, the road was seeded experimentally. After one growing season, it became evident that successful establishment of grass depends on applications of fertilizer at the time of seeding.

TABLE 1.—AVERAGE NUMBER OF STEMS PER SQUARE FOOT, BY TREATMENT

Raking treatment	Fertilized	Not fertilized	Average
Raked	40	31	36
Not raked	36	16	26
Average	38	24	31

TABLE 2.—OCULAR CLASSIFICATION OF ESTABLISHED VEGETATION ON TREATED PLOTS

Treatment	Poor or fair plots	Good or superior plots
Control	15	0
Raking	15	0
Fertilizing	5	10
Raking and fertilizing	4	11

Design of the Experiment

Sixty 25-foot-long plots were established contiguously along the road. Four successive plots constituted a "block" within which four different treatments were randomized. The treatments were: (1) fertilizing with 450 pounds per acre of a 6:10:4 (nitrogen: phosphorus: potassium) commercial fertilizer, (2) raking, (3) raking and fertilizing, and (4) control. Seed was broadcast by hand in the early spring at a rate of 7 pounds per acre and consisted of a mixture of Tualatin oatgrass, alta fescue, perennial ryegrass, and alsike and white clover.

Results and Conclusions

In each of the 60 plots, the number of stems was counted in two randomly located subplots (each 12 inches by 2 inches). Averages are presented in Table 1. Both fertilizing and raking treatments effectively induced the establishment of vegetation. Fertilizing was statistically significant at the 1-percent level of probability; rak-

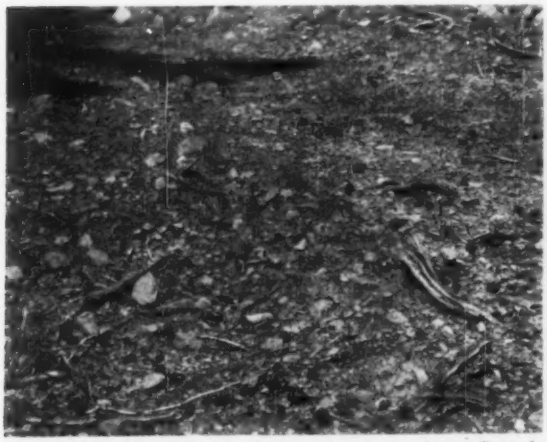

FIG. 1.—This truck road, on the west slopes of the Cascade Range, was abandoned after 2 years of use. The roadbed is compact, and most of the fine materials have been eroded.

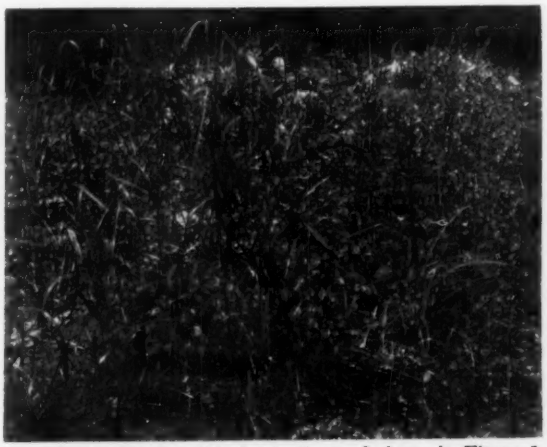

FIG. 2.—An experimental plot in the road shown in Figure 1, after treatment with a 6:10:4 fertilizer and seeding of grass and clover.

ing, at the 5-percent level. No interaction effect was apparent between these two treatments.

A simple count of number of established stems, however, does not provide a complete measure of treatment effect. For example, a plot might include many stems, but these stems may be puny and lack vigor. To complement the stem count, therefore, effects of raking and fertilizing were appraised visually by making an ocular classification (poor, fair, good, or superior) of the vegetation growing on each of the 60 plots. Since the estimator did not know how the plots had been treated, the approach was considered objective. Results are shown in Table 2. In this set of data, only the fertilizing treatment was evaluted as statistically significant (1-percent level of probability).

The stem count and the overall-appearance data furnish different yardsticks for assessing the efficacy of the treatments. The results of these complementary analyses indicate that in the western part of the Cascade Range, fertilizing can increase the chances of obtaining a satisfactory vegetation cover on abandoned truck roads (Fig. 2); and that although raking apparently increases the number of established plants, this treatment alone may not yield a satisfactory cover.

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Spacing and Early Growth of Planted Slash Pine

The age at which competition begins in slash pine (*Pinus elliottii*) plantations is one of the factors which influences the forest manager in his spacing decision. The slash pine spacing study, reported in this paper and conducted on the George Walton Experimental Forest, Dooly County, Ga., establishes relationships between plantation spacing and competition. A secondary feature is the comparison of square and rectangular spacings.

Methods

This study was established in a field which had been under cultivation the previous year. The soil is a loamy sand, composed primarily of the Lakeland and Gilead series. Planting stock was ungraded seedlings from the Herty Nursery at Albany, Ga., and was planted in three-quarter-acre plots of a randomized block design. Two blocks were established, with each block consisting of one plot for each of the eight spacings. Good moisture conditions, freedom from disease and insect attack, a good planting site, good planting stock, and care exercised in handling and planting the seedlings resulted in a survival of 96.9 percent at the end of the fourth growing season.

Results

Tests indicate that competition of a significant degree developed during the fifth year at a density of 500 to 550 trees per acre (Table 1). The significant increase in the effect of stand density during the fifth year, as well as the increasing effect during the sixth and seventh years, is illustrated by the regression lines of d.b.h. on stand density (Fig. 1). The relationship proved to be linear with an increasing slope to the regression line. The density variable accounted for 14 percent of the variation in the fourth year, 56 percent in the fifth, and 85 percent in the sixth and seventh years.

Another example of the increasing effect of stand density is the expanding difference between the mean diameter of the 15x15 and the 6x6 spacing (Table 2). Note that the 15x15 tree is only 4.0 percent larger than the 6x6 at the end of the fourth year, but 23.3 percent larger at the end of the fifth, an increase of 19.3 percent during the one year.

The pattern of diameter growth during the fifth, sixth, and seventh years is a point of interest (Table

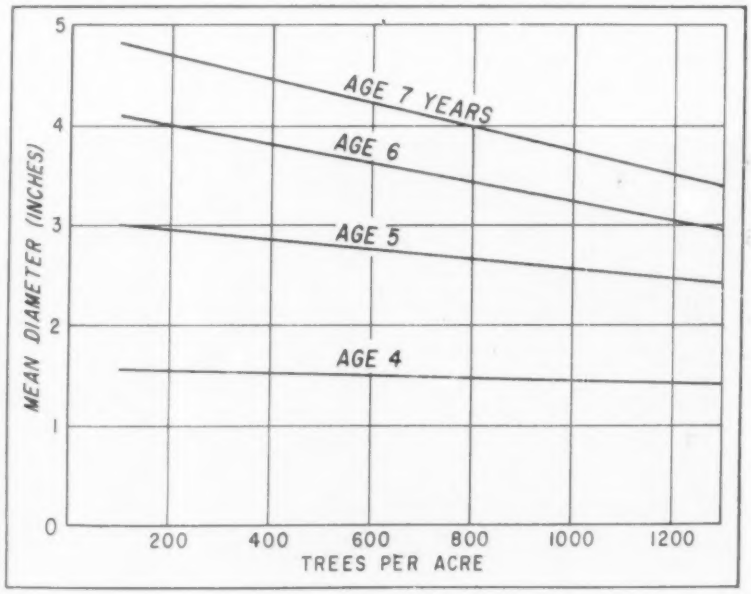

FIG. 1.—Regression lines of d.b.h. on stand density.

TABLE 1.—MEAN DIAMETERS BY SPACING AT THE END OF THE FOURTH, FIFTH, SIXTH, AND SEVENTH YEARS

Spacing (feet)	Trees per acre	Year			
		4	5	6	7
	Number	*Inches*			
6 × 6	1,210	1.49	2.45	2.97	3.39
6 × 8	907	1.39	2.70	3.37	3.96
5 × 10	871	1.38	2.69	3.34	4.02
8 × 8	680	1.31	2.55	3.49	4.07
6 × 12	605	1.40	2.67	3.59	4.11
10 × 10	436	1.62	2.93	3.86	4.47
7½ × 15	387	1.52	2.82	3.73	4.45
15 × 15	194	1.55	3.02	3.96	4.74

TABLE 2.—DIFFERENCE IN THE AVERAGE DIAMETER OF THE 6 × 6 AND 15 × 15 SPACING AT VARIOUS AGES

Year	Spacing		Difference	
	6 × 6	15 × 15		
	Inches		*Inches*	*Percent*
4	1.49	1.55	0.06	4.0
5	2.45	3.02	.57	23.3
6	2.97	3.96	.99	33.3
7	3.39	4.74	1.35	39.8

TABLE 3.—ANNUAL DIAMETER GROWTH BY SPACING DURING THE FIFTH, SIXTH, AND SEVENTH YEARS

Spacing (feet)	Annual diameter growth					
	5th year		6th year		7th year	
	Inches	*Percent*[1]	*Inches*	*Percent*[1]	*Inches*	*Percent*[1]
6 × 6	0.96	64	0.52	21	0.42	14
6 × 8	1.31	97	.67	25	.59	18
5 × 10	1.31	79	.65	24	.68	20
8 × 8	1.24	80	.94	37	.58	17
6 × 12	1.26	90	.92	34	.52	14
10 × 10	1.31	97	.93	32	.61	16
7½ × 15	1.30	93	.91	32	.72	19
15 × 15	1.47	95	.94	31	.78	20

[1]Annual diameter growth as a percent of tree diameter.

TABLE 4.—MEAN HEIGHTS BY SPACING AT THE END OF EACH GROWING SEASON

Spacing (feet)	Mean heights by year[1]						Mean annual growth over 7-year period[2]
	2	3	4	5	6	7	
	Feet						*Feet*
6 × 6	3.0	5.9	8.5	12.4	16.2	20.6	2.9
6 × 8	3.3	6.1	8.3	12.8	17.2	21.4	3.0
5 × 10	3.2	6.1	8.2	13.3	16.9	21.2	3.0
8 × 8	2.6	5.6	7.7	12.3	16.9	21.0	2.9
6 × 12	3.1	5.7	8.1	12.4	17.5	20.9	2.9
10 × 10	3.1	6.0	8.4	12.7	17.3	21.5	3.0
7½ × 15	3.1	5.8	8.4	12.9	17.2	21.0	2.9
15 × 15	3.1	5.8	8.2	12.4	16.6	20.4	2.8
Mean	3.1	5.9	8.2	12.6	17.0	21.0	3.0

[1]Height measurements were not made at the end of the first year; the average height at the time was estimated at 1 foot.
[2]Seven-year heights were adjusted to exclude initial seedling height.

TABLE 5.—AVERAGE CROWN RATIO PERCENTS BY SPACING AFTER SEVEN GROWING SEASONS

Spacing (feet)	Trees per acre	Crown ratio
	Number	*Percent*
6 × 6	1,210	57.5
6 × 8	907	61.5
5 × 10	871	63.5
8 × 8	680	65.3
6 × 12	605	67.8
10 × 10	436	70.7
7½ × 15	387	70.8
15 × 15	194	85.4

3). Growth of all spacings declined markedly during the sixth year, and to a lesser extent during the seventh. Although diameter increment, even in the seventh year, is not completely stabilized in relation to stand density, this relationship should develop within one or two years. As evidence, tree size at the end of the seventh season is, with one minor exception, in direct proportion to stand density (Table 1).

Block analysis of variance of the 7-year data showed spacing configuration — that is, rectangular versus square spacing — to be nonsignificant.

Height growth, as might be expected, shows no correlation with stand density (Table 4). The 8x8 spacing made the poorest height growth initially, but by the seventh year it had reached the average of all spacings.

No volume comparisons were attempted because reliable volume tables for the smaller diameter classes are not available.

Crown ratio percent was measured for the first time at the end of the seventh season, and it, of course, is highly correlated with stand density (Table 5). Regression analysis of these data resulted in the following estimating equation:

Logarithm crown ratio = 2.40054 — 0.20669 logarithm stand density. The stand density variable accounts for 93.4 percent of the variation.

In summary, comparison at seven years of age of eight spacings of old-field planted slash pine showed that:

1. Competition of a significant degree developed during the fifth year at a density of 500-550 trees per acre, with the effect of stand density intensifying in the sixth and seventh years.

2. Diameter growth is not correlated with configuration (rectangular versus square spacing).

3. Height growth is not correlated with stand density.

4. The crown ratio percent after seven years is in direct proportion to stand density.

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The Measurement of Site Quality for Yellow-Poplar[1]

Relationships between certain soil characteristics and the growth of yellow-poplar (*Liriodendron tulipifera* L.) have been established by a number of investigators (*2, 3, 4*). Depth of A_1 horizon, depth to the least permeable layer, depth to mottling, and conditions of the B horizon have been shown to be correlated with growth.

As a general rule these soil characteristics are not found at desirable levels on old field sites. An exception to this situation, however, may be found on the Dobbs Memorial Forest near Terre Haute, Ind., where an old field planting of yellow-poplar established in 1945 shows a remarkable, though variable, pattern of survival and growth.

In the spring and summer of 1958, the senior author tested on this area some of the reported criteria for yellow-poplar growth using a simple field technique for gathering data.

Experimental technique.—Thirty-six trees representing the range of heights to be found in the plantation were selected and their total heights measured. Within a 10-foot radius of each of these trees,4 samples of thickness of A_1 horizon, depth to zone of mottling, and depth to tight subsoil were taken with a Hoffer profile tube. Depth to tight subsoil was assumed to be the limit to which the tube could be forced into the soil. Measurements of the other factors were taken from the extracted core. Soil profile pits were dug during the spring when soil moisture contents were high, and observations were taken at that time on ground water levels and the pattern of root penetration.

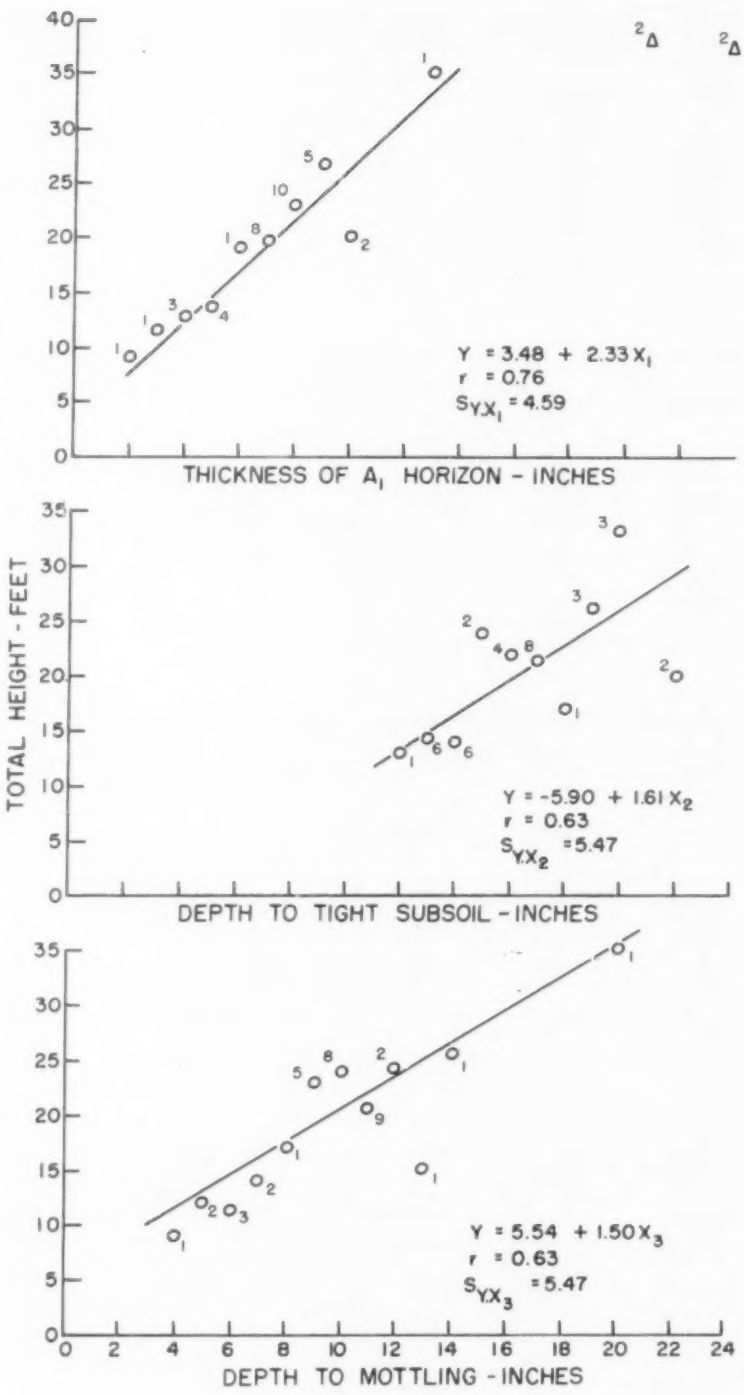
TOTAL HEIGHT - FEET
THICKNESS OF A1 HORIZON - INCHES
Y = 3.48 + 2.33 X1
r = 0.76
SY.X1 = 4.59
DEPTH TO TIGHT SUBSOIL - INCHES
Y = -5.90 + 1.61 X2
r = 0.63
SY.X2 = 5.47
DEPTH TO MOTTLING - INCHES
Y = 5.54 + 1.50 X3
r = 0.63
SY.X3 = 5.47

FIG. 1.—The relationship between total height of 14-year-old yellow-poplar and each of the variables, thickness of A_1 horizon, depth to tight subsoil, and depth to mottling. The extreme values in thickness of A_1 horizon (denoted by Δ) were not included in the statistical analysis.

[1]Journal paper No. 1523. Contribution of the Department of Forestry and Conservation, Purdue University, Agricultural Experiment Station, Lafayette, Ind.

The data were examined for possible relationships existing between tree height (reflecting site quality) and these soil factors.

Results.—Analysis of the data (Table 1) shows that the multiple correlation between tree height and the three soil factors of: (1) thickness of A_1 horizon, (2) depth to tight subsoil, and (3) depth to mottling, as determined by the sampling technique employed, is highly significant ($R^2_{Y.1.2.3} = 0.604$). Individually, thickness of A_1 horizon (X_1) is best correlated with tree height ($r^2_{Y1} = 0.575$), explaining all but 2.9 percent of the variation in tree height which was accounted for by the three-factor combination. Obviously, little is contributed to the multiple relationship by depth to tight subsoil (X_2) or depth to mottling (X_3) even though each of these latter two factors in itself is significantly correlated at the 1 percent level to tree height.

Graphs of the relationships between each of the variables and tree height are shown in Figure 1. It should be noted that the linear relationship between thickness of A_1 horizon and tree height (Fig. 1) may lose its validity at depths greater than approximately 12 inches. This would agree with Auten's data (*1*) which tended to assume a curvilinear relationship beyond depths of approximately 8 inches and which likewise indicated a maximum influential depth of 12 inches.

TABLE 1.—RELATIONSHIP OF SOIL FACTORS TO TOTAL HEIGHT

Soil factor	r^2	R^2
X_1[1]	.575**	
X_2[2]	.395**	
X_3[3]	.394**	
X_1, X_2, X_3		.604**
X_1, X_2		.602**
X_1, X_3		.575**

[1] X_1 = depth of A_1 horizon
[2] X_2 = depth to tight subsoil
[3] X_3 = depth to mottling
**Indicates significance at the 1 percent level.

Observations gathered from the profile pits indicated that planting survival was likely associated with the level of the water table, at least when such levels were near their maximum. Poor survival was present on areas where standing water was found within 9 inches of the ground surface. Fair survival was present where water reached to 16 inches and good survival was associated only with water table depths of 24 inches or greater.

Discussion.—The results obtained from this old field planting agree with those of other investigators who have shown that the A_1 horizon, within limits, closely determines site quality for yellow-poplar. It is also evident that all the soil factors measured were adequately sampled by the technique employed. Though depth of the A_1 horizon explained most of the variation in tree height, the other measured factors of depth to tight subsoil and depth to mottling also showed relationships of statistical significance with height (1 percent level).

The observations made in the soil profile pits indicate that care should be taken when presuming that depth of A_1 horizon will by itself adequately assess the desirability of a site for planting yellow-poplar. There was no apparent relationship between thickness of the A_1 horizon and the depth to the water table during the early spring period. Some areas showing adequate thickness of A_1 horizon for good growth were in places where poor survival apparently resulted from high spring water table levels.

Though not adequately tested in this study, the possibility also exists that present depths of A_1 horizons are not in actuality the causal factor related to observed height growth. Auten (*1*) has noted, for example, that yellow-poplar will grow rapidly in the complete absence of A_1 horizons provided the soil has good physical properties and is well drained, and Coile (*3*) has observed that A_1 horizons can develop as a *result* of yellow-poplar growth. However, even though present thicknesses of A_1 horizons most certainly have been influenced by the growth of the trees themselves, it seems likely that due to the age of this plantation, substantially the same qualitative relationships existed between height growth and A_1 thicknesses at the time of establishment. A_1 horizons are also present on areas within this plantation where yellow-poplar was not established and no tree growth of any type has occurred.

Regardless of the above considerations, however, probing with soil profile tubes for assessing factors relating to yellow-poplar site quality seems to be a successful and useful technique.

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Points of View

Comments on "Economic Models for Thinning and Reproducing Even-Aged Stands"[1]

Although the authors of the cited JOURNAL article have succeeded in presenting their views and conclusions on this subject in a very interesting and convincing way, I find myself forced to take issue with them lest silence be construed as assent and their work be regarded as unchallenged. The comments which I am about to present and the points of issue included are not intended in any sense as an attempt to discredit the authors, but rather to discuss the topic from the point of view of others.

The article in question proposes "economical thinning" on the basis of the production assets of individual trees, so-called "leave-trees."

The idea of setting up thinning models has always been the dream of all forest managers but it has been continually proven that such models can be put into practical use only with the utmost difficulties. These difficulties lie first in the realm of practical application and secondly in the impossibility of establishing the theoretically ideal stand in the forest (*4*). Even yield tables represent only the abstract model of a "normal" stand. If one attempts to approach such an abstract ideal, one encounters a variety of problems. The following discussion of such problems is not intended to dispute the value which such thinning models may possess for *research*, but the difficulties of practical application in management shall be described.

As the authors state, the concept of a thinning degree must be considered not only biologically, but biologically *and* economically. To unite these aspects, it is impossible in practical silviculture to start a thinning operation without having first decided upon the future of the stand. This decision is the major problem. It is, in the view of this author, not settled even by application of the "economic thinning models." Since the stumpage value and uses of forest products change very rapidly in our markets, the thinning models suggested by Fedkiw and Yoho appear to be too inflexible. According to their thinning models those trees should be cut during a thinning which do not correspond in their productivity to the desired value increase.

If the manager decides upon the production of sawtimber, then his thinnings will have to be proportionally heavier than if he, for example, wishes to—and can—produce pulpwood. Once the decision of the expected "alternative rate" of the stand has been made, it will be difficult to adjust to new economic conditions in a changing market.

The problem in thinning lies not in the different thinning grades, as the authors complain, but in the decision of the ultimate economic goal of the stand. Treatment varies dependent upon that goal. In practical application it would seem rather difficult—if not impossible—to thin a stand whenever "economic density" is reached. The "economic density" must be decided upon beforehand and not when "the minimum value of timber capital earning at or above the alternative rate . . . is capable of producing (timber) at the given alternative."

Should the market for sawtimber change and tend to favor small material, then the heavier the first thinnings have been, the more difficult would be an adjustment to the new situation had the manager, applying the theory of Fedkiw and Yoho, decided upon sawtimber production. In this example the smaller trees would have been removed during the first thinnings as "unproductive assets" and irrevocably lost to the small material market. This is not to say that in this case the thinning models of Fedkiw and Yoho are not as good as the classical thinning grades, but very probably they are not better either.

Should the market development be reversed, i.e., should the emphasis switch from small to large material, then a thinning carried out in accordance with the classical thinning grades would be superior to the models suggested by the authors since trees whose increase lay below the "standard of productivity" would have been left in the stand. The sense of the thinning grades—in contrast to Fedkiw's and Yoho's models—lies in the fact that trees with an excellent growth factor and/or high value increase, absorb, and equalize the loss of interest increase of trees with a less favorable increment factor. The "alternative rate" of the stand value under the application of thinning grades and normal market fluctuations, therefore, will always lie somewhat under that of Fedkiw's and Yoho's—at least at the early age of the stand. The manager has, however, the advantage of a healthier economic basis of operation and his economic system can be better adapted to new market conditions than if he

[1] Fedkiw, John, and James G. Yoho. Economic models for thinning and reproducing even-aged stands. Jour. Forestry 58:26-34. 1960.

employed the economic thinning models suggested.

A thinning as suggested by the authors and in accordance with which ". . . (the forester must) decide which assets (trees) do not meet the owner's standards of productivity and which others can be expected to continue to earn a return equivalent . . ." emphasizes the economy and tends to neglect the biological interests. Such proposal reflects the old concept of the theory of highest net revenue for which European foresters paid a high price. The authors concede that "(the operations should be) . . . based on objective economic criteria applied within ranges of biological and engineering alternatives applicable to each particular forest." They even suggest that their models cannot be applied precisely and that varying volumes of operable cut and length of cutting cycle may be used rather than applying the "economic density" as the thinning guide. If the authors are prepared to subject their economic models to the biological alternatives and to dispense with economic density in favor of length of cutting cycle, then the theory of the "leave-trees" is changed to the classical form of thinning and there apparently exists no further distinction between the thinning grades and the "economic models."

On the other hand, the belief that ". . . economic guides (should) tend to lead to the management of the owner's capital so as to obtain maximum earnings" must, of necessity, result in a drastic reduction of the rotation age and even in an accepted loss of heavy-timber production; for only in this way can "maximal earnings" be obtained, at least in areas of pulpwood production. Here arises the question discussed below of how long the soil can endure such short rotations without loss of productivity.

The assertion of the authors that ". . . the forester needs to keep in mind (the expected value) differences from tree to tree . . ." is, in my opinion, the exact opposite of their first proposal. It purports that a forester should not fell a tree if that tree may grow into a higher value class. However, it is precisely when a pulpwood-size tree grows into a larger diameter class that its absolute value rises, but its relative value decreases.

Consequently, an owner who does not speculate on an increasingly inflated economy, which may justify the leaving of a pulpwood tree for further increment growth, should clearcut his stand as soon as it has reached merchantable size and not concern himself with thinning operations or "expected value." One single cleaning operation should suffice in most cases. This would be—in my opinion—"economical thinking." However, as a silviculturist, I am, of course, opposed to such single-track "economical thinking." What soil—in the long run—can withstand such a high rate of productivity? European experience has demonstrated that under such intensive management the production capacity of the soil is exhausted after two or three rotations and then steadily declines until it cannot even produce pulpwood. Here, I believe, lies the essential difference between a factory and a forest. Industry can operate its machines at top productivity; if a part gives out as a result of excessive strain, it is replaced by a new one. If, however, a productive factor in the forest gives out—in this instance the soil—we can replace it either not at all or we can improve it only at great cost.

The suggestion of the authors, in accordance with which the forester is to decide prior to each thinning which of the trees are to be felled, also gives rise to the danger that consideration of the development of the stand in its entirety as well as the management goal may be forgotten in the process. The management goal must be set in advance, for the extent of the thinning can be determined only on the basis thereof and not on the basis of individual trees.[2]

[2]There is no doubt that the selection (marking) obviously must be made on an individual basis.

Wiedemann (*19*) rendered a great service when, in evaluating his experience and results, he was the first to point out that in the consideration of a stand one must take into account the total yield of the stand and not limit oneself to a consideration of the trees remaining. It must be agreed with the authors that the value of a stand can be judged from the value of the single members of the stand. The volume of a stand, however, has to be determined by the productivity of the whole stand. Where there is a market for small material, volume equalizes value. In this case, also, value has to be determined by the productivity of the stand, and not by the value increment growth of the individual tree.

Here lies the problem and, in my opinion, also the charm of the various thinning grades. If the management goal has been determined, the forester can then set the desired thinning degree for the future. Modifications of the thinning degree which may become necessary due to changes in market conditions are more easily possible if one begins with a light thinning.

Were one to follow the suggestions of Drs. Fedkiw and Yoho, the degree of thinning would be determined anew each time thinning was undertaken. Such thinning is impossible in practice! Were one to leave in the stand only those trees which justify the highest interest calculations, one would soon have to convert from thinning in the lower story to thinning in the upper story, because the increment of the thicker boles is, as is known, less than in the slighter boles. In addition, one could soon undertake no more thinning at all since there would no longer be fellable trees present in the stand, a fact proven by the results of the application of the "Borggreve Theory" in Germany. This occurrence is even more probable since the authors take the stand that ". . . as diameter growth rate . . . remains constant while the size of the tree increases, its rate of volume . . . increment declines . . ." The fact of the matter is that the growth

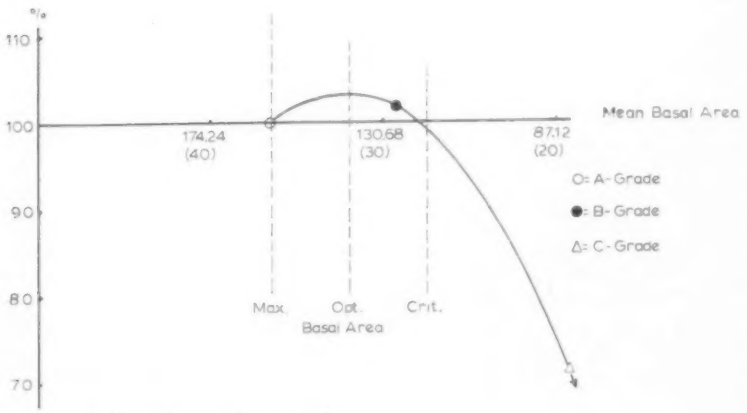
rate decreases, but only percentagewise, i.e., it decreases only in comparison with the existent volume mass.

After this discussion the practicing forester will probably ask, "Why do we have different thinning grades at all?" The answer is, in order to give the forester the opportunity of taking into consideration both the biological *and* economical aspects in his stand, thus making it easier for the manager to determine the intensity of his thinning. In recent years this problem has been discussed extensively in Europe (*1*, *2*, *3*, and *5* to *10*). This discussion proves that the thinning models as introduced by Fedkiw and Yoho do not reflect the true development of a stand, because a heavy thinning in the lower story resulting in a volume loss for the sake of increased value of the remaining individual trees (thereby offsetting the volume ioss) exists only in localities where there is no market for small material.

In areas in which inferior material can be marketed, the value increase after a heavy low thinning does not equal the loss of volume. This is due to the fact that the greater response of the individual tree does not persist long enough after a heavy thinning. The high increase in growth in the remaining trees immediately following thinning is probably because of the decay of the roots of the trees removed which exercises a positive effect upon the nitrogen supply of the remaining trees. At the same time lessened competition and better decay of humus also play an essential role (*5*). These favorable factors do not persist, however; hence the originally strong response decreases rapidly at higher age. It is therefore a mistake to believe that a high growth rate of the remaining trees can be achieved by persistent, forced thinnings. Lightly thinned stands regain the initial growth loss compared with heavily thinned stands and, with age, even overtake the latter.[3] Figure 1 from Assmann (*5*) makes this clear. In this example the volume growth rate in an oak stand is illustrated; it can be considered typical of other experimental areas as well. An A-Grade[4] thinning equals 100 percent. This 100 percent corresponds therefore to the maximum natural growth, or a stand density of 1.0, with a mean basal area of 148.99 square feet, which also represents the maximum basal area. In a B-Grade thinning the maximum growth is exceeded and reaches an optimum basal area of 139.39 square feet and a stand density of 0.88. There is a possibility, as Assmann (*3*) points out that under certain conditions (on best sites) maximum and optimum basal area may be identical. The growth begins to culminate at the optimum basal area.

A B-Grade thinning in a dense, evenly growing stand leads therefore to an extraordinarily rapid increase in rate of volume growth. This decreases, however, in the further course of development, and the densest stands, i.e., those most lightly thinned, move into the lead. In Figure 1, the results of a 60-year experiment still show the typical, though relatively flat, optimum curve. The critical basal area is attained when yields from thinning are higher than the periodic increment growth but still constitute about 95 percent of the maximum growth. In the example presented it is located at a basal area of 119.79 square feet and a stand density of 0.75. Finally, in a C-Grade thinning the volume yield of the stand decreases very rapidly and equals at the end of rotation approximately 72 percent of the A-Grade thinning. Table 1 from Assmann (*5*) gives the actual values for the example in Figure 1. This table makes clear that the growth after a C-Grade thinning lies below that of A-Grade or B-Grade thinnings. However, on the

[3]These conclusions are naturally valid only for "normal" stands with an initial density of 1.0.



Basal Area	Sq ft. (Sq m)	Natural Density
Max.	148.99 (36.5)	1.00
Opt.	139.39 (32.0)	0.88
Crit.	119.79 (27.5)	0.75

FIG. 1.—Increment growth and development of oak stands between 86 to 144 years of age (*5*).

[4]A-Grade thinning—removes all suppressed, dead and dying trees.

B-Grade thinning—removes same as in A-Grade, but in addition all overtopped trees which are still viable, dominant and codominant trees as far as they are either jammed, badly formed, defective, whippers or sick trees, but not necessarily dying.

C-Grade thinning—removes like B-Grade, but in addition opens up the dominants to increase crown space and decrease competition.

other hand, the initially higher growth of the B-Grade thinning is surpassed with increasing age by growth after an A-Grade thinning.

It would be an entirely false assumption were one to conclude from these results that conifer stands, for example, should now no longer be thinned until the stands reach an age of 50 or 60 years. Early, repeated, light thinnings of short cycles further growth (*5*), favor, above all, an even crown development, prevent "bend trees" after thinning, and thus effect a greater insurance against snow breakage.

The above discussed phenomenon is typical for the European experimental plots, some of which are over 100 years old, as long as like areas are compared with one another. There is no reason to assume that a similar result should be impossible or improbable in the United States. It must be mentioned that some authors are critical of these results (*1, 9, 10, 11, 18*) but still the outcome of Assmann's experiments (*2, 3, 5, 6, 7*) is so convincing that we must free ourselves from the old classical theory (*19*) according to which thinnings cannot positively influence the total volume increment of a stand.

These results, of course, hold true only when we are concerned with the volume in cubic feet, in so far as it affects economy. Thus the calculation above is of value only in which smaller material from thinning can be absorbed by a market, i.e. chiefly pulpwood areas. If, on the other hand, one is concerned with areas like the northwest of the United States in which the timber volume per area unit is generally only of interest when it can be measured in board feet, there no longer exists superiority of light thinning at advanced age because inferior material cannot be disposed of in any quantity due to lack of a market. Here, however only here, it is economically feasible to introduce a heavy thinning because it offers the only possibility of obtaining salable diameter classes of individual trees within a reasonable rotation period. This may also be regarded as economically feasible even when the total volume of the stand suffers as a result. If, however, in the future a market for smaller timber grades develops, then the forester here in the Northwest will also have to switch from the consideration of volume increment of the single tree to volume increment of the entire stand. Here lies the problem of volume and value increment growth and this problem raises some question pertaining to Fedkiw's and Yoho's theory.

The forester must decide in advance whether the value increment of the individual trees justifies a volume loss. If it does not, then his decision of what degree of thinning is desirable must be based upon (a) what he determines to be the rotation age, and (b) the economic goal he selects. If he desires a high volume at the end of rotation, then a light thinning will be preferable to a heavy thinning. If, on the other hand, he desires volume and value, he will perhaps begin with a light thinning and change later to a more moderate degree. This will be of the greatest advantage when pulpwood and sawlogs can be cultivated in the same stand. The thinning yield

TABLE 1.—OAK THINNING PLOTS. AVERAGE BASAL AREA AND INCREMENT

Period of increment growth, age from—to	Number of years period	Thinning grade	Average basal area		Annual periodic increment basal area		Annual periodic increment volume	
			sq. ft. (sq.m)[1]	%	sq. ft. (sq.m)	%	cu. ft. (cu.m)[2]	%
86—91	5	A	210.8 (28.4)	100	1.830 (0.420)	100	514.5 (7.2)	100
		B	105.4 (24.2)	85	1.873 (0.430)	102	500.2 (7.0)	97
		C	91.0 (20.9)	74	2.039 (0.468)	111	443.0 (6.2)	86
91—103	12	A	137.2 (31.5)	100	2.239 (0.514)	100	593.1 (8.3)	100
		B	117.2 (20.9)	85	2.309 (0.530)	103	643.1 (9.0)	108
		C	92.4 (21.2)	67	2.104 (0.483)	94	557.4 (7.8)	94
103—116	13	A	151.6 (34.8)	100	1.877 (0.431)	100	614.5 (8.6)	100
		B	128.5 (29.5)	85	2.161 (0.496)	115	657.4 (9.2)	107
		C	82.8 (19.0)	55	1.599 (0.367)	85	464.5 (6.5)	76
116—125	9	A	165.1 (37.9)	100	1.699 (0.390)	100	628.8 (8.8)	100
		B	135.0 (31.0)	82	1.755 (0.403)	103	736.0 (10.3)	117
		C	82.3 (18.9)	50	1.390 (0.319)	82	414.5 (5.8)	66
125—137	12	A	179.9 (41.3)	100	1.581 (0.363)	100	564.5 (7.9)	100
		B	134.6 (30.9)	75	1.716 (0.394)	109	578.8 (8.1)	103
		C	85.8 (19.7)	48	1.189 (0.273)	75	385.9 (5.4)	68
137—144	7	A	184.31 (42.3)	100	2.269 (0.521)	100	814.6 (11.4)	100
		B	134.2 (30.8)	72	1.803 (0.414)	79	600.2 (8.4)	74
		C	95.0 (21.8)	52	1.442 (0.331)	64	550.2 (7.7)	68
86—144 (1897-1955)	58	A	158.1 (36.3)	100	1.908 (0.438)	100	618.82 (8.66)	100
		B	128.5 (29.5)	81	1.999 (0.459)	105	629.54 (8.81)	102
		C	87.6 (20.1)	55	1.603 (0.368)	84	466.61 (6.53)	75

[1]Converted from square meter/hectar to square feet/acre by using 1 square m/ha = 4.356 sq. ft./acre.

[2]Converted from cubic meter/hectar (excluding top diameters less than 7 cm) to cubic foot/acre by using 1 cbm/ha = 71.457 cb. ft./acre.

will then provide him with pulpwood and the final cutting with the sawlogs. From the standpoint of biological silviculture it would virtually be a crime, were the forester, for the sake of higher possible income, to produce only pulpwood in such a stand, i.e., according to Figure 4 of the article by Fedkiw and Yoho; the rotation age would approach "optimal reproduction age."

If we agree on the theory of sustained yield, we cannot think only of today's profit; we must also consider an "economy of long duration" which takes into account both economic and biological factors. From this point of view different thinning grades which keep the productivity of the site balanced seem to be more than justified even if they result in some sacrifice of total or future income. With our present knowledge of silvics we cannot expect maximum anticipated growth rate of the trees to be the only basis for valuation. There are ways to obtain the *relative* maximum income from a forest without doing harm to the site. So let us not degrade the "soil rent doctrine" to an instrument of economy only!

In this connection I might perhaps mention the value of thinning reserves. Following the suggestion of Fedkiw and Yoho, one should cut each tree whose value increase no longer corresponds to the desired alternative rate. This is debatable! Each landowner should, according to his individual needs, build up a "thinning reserve" of trees left in the stand as long as they are healthy and do not hinder the growth or development of other members of the stand. By following this policy, the owner will build up "thinning reserves" which do not harm his stand but actually constitute a "savings account." The "amount" left in this "savings account" should, of course, not exceed the requirements of the landowner, but should be based upon his possible needs. These remaining trees are the ones —particularly for small landowners with even-aged stands—which should pay for the marriage of the daughter or the birth of the grandchild. Such trees represent an emergency reserve which can be cut at any time, thus making the owner independent of his thinning cycles. (It may also be a welcome source of additional money in times when lumber prices are high.)

One could raise the following question here: Why leave an investment in an account without interest when the money may be transferred to another account at interest? Such a question naturally has justification for theoretical evaluation and for owners of large timber stands with extensive management plans. The case of small woodlot owners is, however, quite different in practice. They generally invest the additional money resulting from a cutting of a future thinning reserve not in an interest-bearing account but in luxury articles whose "interest," if any exists at all, is purely ideal. In addition, as pointed out above, one should not imply, when speaking of the establishment of thinning reserves, that they are to be developed to the maximum, but rather only that an extra volume should be built up in the stand until a healthy and economically feasible reserve has been created.

Caution is advised in the development of such thinning reserves for as soon as the thinning reserves start to hinder the growth of the remaining stand, thus forming thinning *arrears*, they should be cut since they then begin to lead to a decline of the maximum growth rate and thus reduce the expected optimum value.

There are two main questions involved in thinning (regardless of whether we are dealing with even or uneven-aged stands):

(1) How can the forester, by thinning, help to create a healthy vigorous stand and take full advantage of the quality of the site?

(2) How can the forester accomplish this goal with the highest possible income?

The importance of these two points should never be reversed! After all, forest management can never be compared with the economic forms of an industry; a forest is not only a wood factory!

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Comments on "Multiple Use"

Mr. Clepper's article in the August issue of the JOURNAL OF FORESTRY[1] was a very fine message to our visitors at the World Forestry Congress, with the exception of one point which we feel is inconsistent with his thesis and also inconsistent with "sound forestry." Mr. Clepper states that "Our forests must be more intensively managed in order to provide the goods and services that are essential to our way of life. Wood and wood fiber will be needed in greater volume, but so will water from our forested watersheds, and forest forage for domestic livestock." How can we manage a forest more intensively while attempting to provide "forest forage" for domestic livestock?

Since "Multiple Use of Forest Lands" was the theme of the Fifth World Forestry Congress, now is a good time to reorient ourselves on this issue and to clarify the meaning of multiple use. To say that rangeland within the boundaries of a given forest provides forage for domestic livestock is one thing; but to say that forest forage is needed for domestic livestock is quite another. Those of us who must interpret forestry principles to a farmer, who cannot understand why he should not allow cattle in his woods, can ill afford to have appealing, but ill defined slogans working against us.

There is ample literature available which demonstrates emphatically that grazed forests are neither good pasture nor productive forest land; pasturing and forestry do not profitably mix on the same area. Of course, we use the "multiple use" slogan and we think it is an excellent one, but it must be clearly understood and correctly applied. We feel that the majority of foresters are willing to concede the fact that there are other land uses besides forestry and that there is a limit to the benefits one derives from forest land.

Undoubtedly, Mr. Clepper did not intend what his statement implied and a professional forester surely will understand what really was intended. In this line of thought though, how does one explain the presence of a cow on the official seal of the Fifth World Forestry Congress as printed in the same issue of the JOURNAL OF FORESTRY?

During a recent field trip by the forest soils group of the International Soil Science Congress, some of our fellow foresters from several European countries were inadvertently shown through a forest that was being grazed by cattle. To say that our friends from abroad were amused at our kind of land husbandry is putting it mildly; they laughed out loud. Fortunately, none of them asked for an explanation of this scene regarding our multiple use concept. In view of what is written in our professional JOURNAL, what could we have said?

CHARLES MEDVICK and
KENNETH P. ROBERT
Madison, Wis.

[1]Clepper, Henry. The forestry profession in America. Jour. Forestry 58:596-597. 1960.

Setting the Record Straight

In the Point of View "Technical Training for Nonprofessional Field Personnel in Forestry and Conservation," page 726, September 1960 issue, the new Woodsman's Training Course at the North Central Agricultural School (sponsored by the University of Minnesota) at Grand Rapids, Minn., was indicated to be of 12 weeks' duration. The JOURNAL has been advised by the school that the Woodsman's Training Course is a six-month program conducted 8 hours per day, five days per week.

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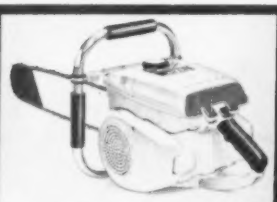

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Book Reviews

Loblolly Pine: Its Use, Ecology, Regeneration, Protection, Growth and Management

By W. G. Wahlenberg. 603 pp. Illus. Published by the Duke School of Forestry, in cooperation with Forest Industry and the Forest Service, U. S. Department of Agriculture. Printed by the Seeman Printery Inc., Durham, N. C. $7. (Review from page proof.)

A universal problem in forestry is to keep up to date with the continuous flow of new information and to make effective use of that previously published. Those dealing with a widely distributed species have an especially difficult job in this regard. The new book on *Loblolly Pine* by W. G. Wahlenberg has been written to bring into one place the total accumulation of information for such a species. It will be welcomed gratefully by those directly involved in the management of loblolly pine. It will be of great service, also, to those of us with an indirect interest in loblolly pine and in southern forestry.

The book is a fit companion for Wahlenberg's earlier volume on *Longleaf Pine* printed in 1946. Both involved a painstaking search for source material and its scholarly review and appraisal. For *Loblolly Pine* almost 1,500 publications are listed. Weaving this mass of information into an interesting, readable, and technically correct presentation was a task of major proportions. The author has succeeded admirably. Loblolly pine grows under widely varying conditions over a tremendous geographic range. Localized research and experience tend to point up differences rather than similarities in responses to management. Even the basic silvicultural system to be used has been a point of contention with loblolly pine. All these differences are appraised in the book. They add seasoning to the fundamental similarities which prevail throughout the range of the species.

There is a brief introduction emphasizing the importance of this tree to the South and to the nation. The loblolly-shortleaf pine type is the dominant cover on 53 million acres. About half the yellow pine in the South is loblolly pine. The great promise it has in the forestry outlook for the future is pointed out.

Following the introduction are nine chapters with headings as follows: (1) The Species and its Environment, (2) Protection, (3) Natural Regeneration, (4) Artificial Regeneration, (5) Growth and Yield, (6) Management of Immature Timber, (7) Management of Mature Timber, (8) Management for Other Purposes, and (9) Properties and Uses. Each chapter is summarized in a page or two, adding to convenience as a reference. An ample appendix provides some of the direct aids to management needed by loblolly pine foresters.

The book is well illustrated with charts, drawings, and a few selected photographs. Tabular data support many significant points in the text. Footnotes are used freely to elaborate on specific items.

Mr. Wahlenberg knows loblolly pine and has a large fund of personal experience to draw on. This adds special flavor to the presentation. In numerous cases the author's previously unpublished material is brought into the text to strengthen a point. Throughout the sections on silvics and silviculture in particular, this intimate knowledge of the tree and its associates is evident and adds strength to conclusions.

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loblolly pine forest is recognized as a fundamental ecological problem in which the hardwoods that naturally replace pine in the course of succession need to be held in check. The means of maintaining this curb on unwanted growth, the natural processes which make some control necessary, and the results of successful accomplishment, provide a thread of continuity through much of the book. The threat from competition naturally is greatest during the regeneration period. The relationship of pine to hardwoods at this stage in management has received much study and this is reflected in the material presented. However, in other sections of the book also, the reader is reminded again and again that hardwoods are a part of the loblolly pine complex and have part in the management process.

A problem in the writing of a species monograph may be the treatment of specialized subjects which have been thoroughly reviewed and published rather recently. A full presentation of the subject leads to unnecessary duplication. Yet a simple reference to another source fails to satisfy the purpose of the monograph. The author has followed a middle course successfully in his chapter on Artificial Regeneration. Wakeley's *Planting the Southern Pines* was published in 1954. Since that publication date additional material has been written up. Wahlenberg has presented what is new in sufficient detail, together with a broader treatment of what was included in the previous summary. The result achieves his purpose effectively.

In line with the comprehensive nature of this treatise an entire chapter is devoted to wood properties and uses. Reader interest will be broadened by the attention given this subject. In part, the space devoted to utilization reflects the amount of information developed in the products research of recent years. Perhaps, also, it indicates a broadening of outlook among forestry interests to include the entire cycle of forest production and use.

If the book has a weakness worth noting it results from the breadth of coverage attempted. Source material for the chapter on Production for Other Uses naturally is limited. Past experience and research have been largely on the production of timber. Only rather recently has there been enough effort directed at other uses of southern forests that some of the unknowns are being replaced with factual bases for management. As a result the picture has had to be filled in with more generalization than is characteristic of other chapters. Multiple use is a timely subject and many readers will be pleased to see it given prominence.

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contribute significantly to future progress. Southern foresters should have it close at hand on the reference shelf. Elsewhere in this country and abroad it will add to a better understanding of the characteristics and management of the most widely distributed of the southern pines.

ROBERT D. MCCULLEY
Lake States Forest Expt. Sta. Forest Service, U. S. Dept. Agric., St. Paul, Minn.

An Introduction to American Forestry

By Shirley Walter Allen and Grant William Sharpe. 3rd ed. 466 pp. Illus. McGraw-Hill Book Company, Inc., New York. 1960. $7.95.

Here is a textbook that can be grouped with the forestry classics. First published in 1938, revised in 1950, this well-known and widely-used text again has been amply revised and brought up to date in this its third edition.

And as in the past, this "new" book will continue to serve as guidance and inspiration to the new supply of students who enter our forestry schools annually, and yet many of these have only vague and sometimes fanciful reasons for selecting forestry as a profession. Basic instruction in this subject can aid the student significantly in choosing the right vocation, be it forestry or not. Certainly after studying the text the reader should have a much better understanding of the broad field of forestry and the place for the forester therein.

"Forestry is more than just a formula," say the authors. And from this they develop the topic that forestry is a science, an art, a business, and a public policy. This concept should be more fully understood by all segments of the profession.

The subject matter covered by *An Introduction . . .* has an appeal and interest that extends beyond the classroom. Foresters—old timers and all—and those in allied fields would enjoy the illustrations and narratives that deal with the historical phases of American forestry. Those more interested in mundane topics will find the technical segments of the book rewarding.

Allen and Sharpe conclude their preface with the "hope that this book will stimulate its readers to do some real thinking about forestry problems and that it will make friends for the movement to manage our forest resources wisely." This statement summarizes well the spirit of the text.

MARLIN H. BRUNER
Clemson College Clemson, S. C.

Timberland Appraisal Guide

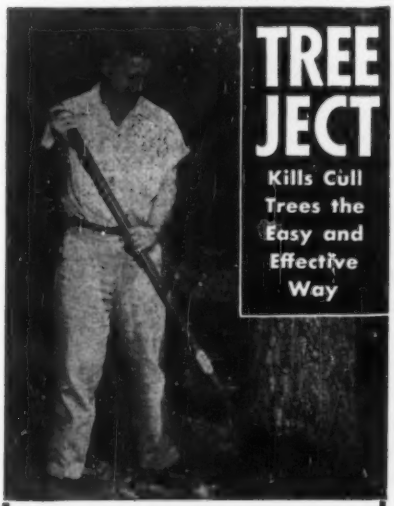
13 pp. Vermont Tax Department, Montpelier. 1960.

Assessors' Handbook—The Appraisal of Timber Property

118 pp. California State Board of Equalization, Sacramento. 1960.

From widely separated states in recent months have come important new tools for assessing officials concerned with the application of the property tax to forest land and timber. The publications reviewed here continue a significant development initiated some eight years ago when the State Tax Commissions of Idaho and Washington issued their timber appraisal manuals for use of assessors.

The Vermont manual, the briefer of the two, was prepared jointly by state tax and forestry officials with the assistance of forest owners, consulting foresters, and local assessors (known in Vermont as listers). The importance of the timber resource both to the local community and to the state is recognized and the fact that this resource can only be maintained and built up if timber owners are able to realize a fair return on investment. The need for assessed values that will not lead to premature liquidation of growing stock is accordingly stressed. The manual is intended to be of general assistance only, and listers are urged to obtain technical aid from consulting foresters, county foresters in the employ of the state forestry



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department or others when the need arises.

Six broad assessment classifications are established: waste land, brush land, seedlings and saplings, pole size timber, young sawtimber, and merchantable sawtimber. Typical conditions are illustrated by photographs. A suggested range of fair market values is provided for each classification and listers are urged to set values within each class based on timber volume, quality, assessibility and other considerations. Listers are urged to view individual timber tracts at least once every 10 years. Special mention is made of problems arising in the assessment of maple sugar orchards and Christmas tree plantations.

The Calfiornia manual, prepared under the direction of the State Association of County Assessors, stems from awareness of the contribution that improved forest assessment practices can make to the stability of local economies in the timber counties of the state. Chapter headings indicate the scope of the handbook: the value of timber property, the appraisal process, appraisal procedure, determination of basic appraisal factors, operations, forms, timber and land value schedules, and timber inventory methods. The appendix includes examples of the application of timber appraisal methods, suggestions for mapping, and tables showing present worth valuation factors.

The manual lists three steps in the appraisal process: (1) determination of acreage and timber inventory, (2) determination of "retail" stumpage values in the light of quality, location, log and lumber haul and other factors, and (3) application of discount factors and factors of safety in order to arrive at present values. For the latter purpose, timber operations are classified as follows: liquidation, deferred income, operating (long term and sustained yield), and combination.

Perhaps the most interesting aspect of the California handbook is its emphasis upon the time factor in timber appraisal and the need for taking into consideration individual owners forest management plans where this is practical. "The time factor is extremely important, and great care should be exercised in its determination. The emphasis in an appraisal is based on net future benefits. Even though the possibilities of a long term operation following present plans closely are statistically remote, a time factor based on sound reasoning and projected trends is perfectly valid in the appraisal process" (Page 26).

The manuals under review pave the way for improved timber assessment and hence more reasonable tax burdens upon forest enterprise in the two states concerned. They also possess broader significance in demonstrating the progress being made in the application of the property tax to timber and, more specifically, in their emphasis upon productivity or income potential in timber valuation for tax purposes.

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SAF members who might wish to request translations of foreign biological material that is of high scientific quality and that will fulfill a scientific need may do so on forms provided for that purpose. The forms can be obtained from the Society of American Foresters or from the AIBS, 2000 P Street, N. W., Washington 6, D. C.

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The Mineral Nutrition of Canadian Pulpwood Species: I. The Influence of Nitrogen, Phosphorus, Potassium, and Magnesium Deficiencies on the Growth and Development of White Spruce, Black Spruce, Jack Pine, and Western Hemlock Seedlings Grown in a Controlled Environment

By H. S. D. Swan. Technical Reports Series 168. 66 pp. Illus. Pulp and Paper Research Institute of Canada, Montreal. 1960. $5 (with color plates).

This mimeographed paperbound report is the first in a series covering both laboratory and field studies on the mineral nutrition of Canadian pulpwood species to be published by the Pulp and Paper Research Institute of Canada. This first volume describes the first season's results from greenhouse pot cultures of the four species.

The objective of the research program is to define the mineral nutrient requirements of white spruce, black spruce, jack pine, and western hemlock as a guide toward improved soil management practices in the nursery and the use of fertilizers in the field to increase pulpwood production. Only one small step forward has been taken in this first report toward the achievement of the ambitious objective.

Of special interest is the description in detail with diagrams and specifications of the pressure subirrigated pot cultures with complete instructions for anyone who might wish to install a similar arrangement. The reaction of the four test species to the different nutrient cultures is shown rather well in 14 color plates. However, most plant physiologists would have appreciated more photos in greater detail such as are included for several species-nutrient combinations. Unfortunately, some of the plate legends leave the careful reader somewhat confused as to which pot is which.

This experiment attempts to elucidate in 80 unreplicated pots proper nitrogen, phosphorus, potassium, and magnesium levels for optimum growth of the four species. Criteria of growth are dry weight of the above ground portions of 20 seedlings from each pot and chemical analysis expressed in percent of the combined needle and stem tissue. The findings are interesting, show trends, and will certainly be helpful in designing future work along the same lines. However, the utility of the data is severely limited by lack of replication, failure to thin pots to a uniform density (this somewhat invalidates dry weight data), and the distressing use of the whole plant above ground for chemical analysis. The author acknowledges this deviation from accepted procedure. However, since most workers in tree physiology are careful to separate plant components before analysis, the combining of tissues will make the correlation of data with other workers much more difficult.

The author also makes several somewhat naive observations based on the findings. Certainly it is not news to any nurserymen from Quebec to British Columbia that jack pine seedlings grow much faster than any of the other species tested. Also, the potassium-magnesium interactions, although quite in accord with the findings of other workers in fertility trials, do not justify the contention of the author that abnormally high concentrations of foliar potassium in natural soils could indicate an abnormally low level of magnesium in the soil.

DONALD P. WHITE
Michigan State University, East Lansing

Current Literature

Compiled by LOIS MCALLISTER, *Assistant Librarian, State University College of Forestry at Syracuse University*
Range Management Section Compiled by NELLIE G. LARSON, *Library, U. S. Department of Agriculture*

General

Just About Everything in the Adirondacks. By W. C. White. 101 pp. Adirondack Museum, Blue Mountain Lake, N. Y. 1960. $3.50.

Operation Multiple Use; Program for the National Forests. By U. S. Forest Service. 16 pp. Illus. U. S. Dept. of Agric., Washington 25, D. C. 1960. PA 424.

A Pictorial Guide to American Gardens. By L. H. Frohman and Jean Elliot. 368 pp. Illus. Crown Publishers, Inc., New York. 1960.

Conservation

Free Films on Forest Conservation. 28 pp. State Univ. of New York College of Forestry, Syracuse, N. Y. 1960.

Farm Forestry

Managing the Farm Woodlot in New Jersey. By A. N. Lentz. 15 pp. Illus. State Univ. College of Agric. Ext. Serv., New Brunswick, N. J. 1960. Ext. Bul. No. 341.

BOOKS AVAILABLE

The Charles Lathrop Pack Forestry Foundation has made available to the Society of American Foresters a limited number of copies of the following books.

LONGLEAF PINE, by W. G. Wahlenberg. 1946 (in cooperation with the Forest Service, U. S. Department of Agriculture). 429 pp. ill. Price $5.

RESEARCH IN THE ECONOMICS OF FORESTRY, edited by William A. Duerr and Henry J. Vaux. 1953. 475 pp. Price $6.

THE FOUR FORESTS AND THE FUTURE OF THE SOUTH, by I. F. Eldredge. 1947. 65 pp. ill. Price $1.

PUBLIC POLICY TOWARD PRIVATE FOREST LAND IN SWEDEN, NORWAY, AND FINLAND, by R. E. Marsh. 1954. 80 pp. Price $1.

LAND HUNGER IN MEXICO, by Tom Gill. 1951. 84 pp. Price $2.

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Forest Economics

Financial Management of Large Forest Ownerships; Papers Presented at the 13th Industrial Forestry Seminar, New Haven, Conn. January 1960. 124 pp. Yale Univ. School of Forestry. 1960. Bul. No. 66. $2.

Forest Influences

Vegetation Types of the San Bernardino Mountains. By J. S. Horton. 29 pp. Illus. Pacific Southwest Forest and Range Expt. Sta., Berkeley, Calif. 1960. Tech. Paper No. 44.

Water Resources of a Western New York Region; A Case Study . . . in the Genesee Valley and Western Lake Ontario Basin. By E. F. Bordne. 149 pp. Syracuse Univ. Press, Syracuse, N. Y. 1960. $3.

Forest Management

Aerial Volume Tables for Ponderosa Pine Type in the Rocky Mountains. By K. E. Moessner. 6 pp. Tables. Intermountain Forest and Range Expt. Sta., Ogden, Utah. 1960. Research Note No. 76.

Fifty Years of Management at the Harvard Forest. By E. M. Gould, Jr. 29 pp. Illus. Harvard Forest, Petersham, Mass. 1960. Bul. No. 29.

Forest Resources

Forest Statistics for Southeast Washington. By J. T. Bones and J. E. Simonson. 40 pp. Pacific Northwest Forest and Range Expt. Sta., Portland, Ore. 1960. Forest Survey Report No. 136.

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A Demonstration of Watershed Protective Logging, Mars Hill Municipal Watershed, Madison County, N. C. 7 pp. Illus. TVA Div. of Forestry Relations, Norris, Tenn. 1960. TVA Report No. 233-60.

Should I Roof My Lumber? By T. M. Headlee. 5 pp. Illus. Central States Forest Expt. Sta., Columbus, Ohio. 1960. Tech. Paper No. 171.

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Biology, Ecology, and Taxonomy of Insects Infesting Acorns. By Jerome Brezner. 39 pp. Illus. Univ. of Missouri, Agric. Expt. Sta., Columbia. 1960. Res. Bul. No. 726.

Insect Pests of Flowers, Seeds and Fruits of Forest Trees. By R. N. Mathur, Balwant Singh, and Kishori Lal. 105 pp. Manager of Publications, Delhi, India. 1958. Indian Forest Bul. No. 223. 11s. 6d.

Sitka-Spruce Weevil. By K. H. Wright. 6 pp. Illus. U. S. Forest Service, Washington 25, D. C. Forest Pest Leaflet No. 47. 1960. 5 cents (Govt. Print. Off.)

The Virginia Pine Saw-Fly Outlook 1955-1959. By T. McIntyre. Illus. Northeastern Forest Expt. Sta., Upper Darby, Pa. 1960. Forest Research Note No. 99.

The Zimmerman Pine Moth; An 8-Year Study of Its Natural History in Illinois Coniferous Plantations. By R. G. Rennels. 39 pp. Illus. Illinois Agric. Expt. Sta., Urbana. 1960. Bul. No. 660.

Range Management

Absorption of Water by Plants. By R. O. Slayter. 47 pp. In Botanical Rev. v. 26, No. 3, July-Sept. 1960. New York Botanical Garden, New York 58, N. Y. $2.

Bermudagrass for Forage in Alabama. By C. S. Hoveland. 22 pp. Alabama Agric. Expt. Sta., Auburn. 1960. Bul. No. 328.

Effect of Gibberellic Acid and Cold Treatments on the Germination of Bitterbrush Seed. By B. R. McConnell. 4 pp. Pacific Northwest Forest and Range Expt. Sta., Portland, Ore. 1960. Res. Note No. 187.

Herbage Production and Carrying Capacity of Bitterbrush. By R. L. Hubbard,

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H. R. Sanderson, and D. Dunaway. 6 pp. Illus. Pacific Southwest Forest and Range Expt. Sta., Berkeley, Calif. 1960. Res. Note No. 157.

Poisonous Larkspurs Identification and Control. By J. M. Tucker and Others. 12 pp. Illus. Calif. Agric. Ext. Serv., Berkeley. 1960. Agric. Ext. Leaflet No. 129. Folder.

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Usable Forage Under Pine Stands? By J. H. Ehrenreich. 2 pp. Central States Forest and Range Expt. Sta., Columbus, Ohio. 1960. Sta. Note No. 142.

Vegetation and Cattle Response Under Two Systems of Grazing Cane Range in North Carolina. By R. H. Hughes, E. U. Dillard, and J. B. Hilmon. 27 pp. No. Carolina Agric. Expt. Sta., Raleigh. 1960. Bul. No. 412.

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Cottonwood Plantations for Southern Bottom Lands. By L. C. Maisenhelder. 24 pp. Illus. Southern Forest Expt. Sta., New Orleans, La. 1960. Occasional Paper No. 179.

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Thinning of Eastern Cottonwood in Missouri. By D. J. Neebe and P. W. Fletcher. 29 pp. Illus. Univ. of Missouri, Columbia. 1960. Res. Bul. No. 733.

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The Interrelationships of Soil Physical Conditions and Drainage. By J. F. Lutz. 27 pp. Illus. North Carolina Agric. Expt. Sta., Raleigh. 1960. Tech. Bul. No. 139.

Wildlife Management

Basal Metabolism of White-Tailed Deer, a Pilot Study. By Helenette Silver, N. F. Colovos, and H. Hayes. Pp. 434-438. New Hampshire Fish and Game Dept., Concord. 1959 (?) Tech. Circ. No. 18.

The Everglades Deer Herd Life History and Management. By C. M. Loveless. 104 pp. Illus. Pittman-Robertson Project. Federal Aid Project W-39-R. A Contrib. Florida Game & Fresh Water Fish Commission, Tallahassee. 1950. Tech. Bul. No. 6.

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Chemical Conversion Products from Wood. By E. G. Locke. 12 pp. U. S. Forest Products Lab., Madison, Wis. 1960. Report No. 2179.

Status of the Bald Eagle, Summer of 1959. By C. S. Robins. 8 pp. Maps, tables. U. S. Fish and Wildlife Service, Washington 25, D. C. 1960. Wildlife Leaflet No. 418.

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"If a man is willing, or even eager, to carry out the preformed decisions of his superiors, but lacks the technical knowledge and the practical skills to do so, the decisions may never be executed at all, and certainly not properly. If he has the knowledge and training, on the other hand, but is vehemently opposed to the decisions he is called upon to execute, the results may be equally disastrous from the point of view of his leaders. It takes both the will and the capacity to conform for a member of an agency to do his job as the leaders of the agency want it done. The Forest Service therefore tries to get people who have both."—From *The Forest Ranger* by Herbert Kaufman (Johns Hopkins Press).

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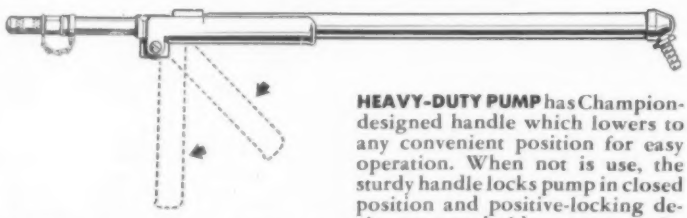

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Council's Column

What Is A Forester?

What is a forester? This most fundamental question has been asked since the beginning of American forestry. Because it asks what people do and hence how they are identified, it is the key term in the trilogy of forest, forestry, and forester. Once the forester was a voice crying in the wilderness to protect, save and somehow manage. Everything that had something to do with the forest came within his ambit. The concept of conservation historically grew out of the forestry movement. Now, a number of fairly well-defined fields have emerged and some, wildlife management and wood technology especially, have drawn considerably apart. A larger interest in all natural resources has grouped under that very general term, conservation. The concept of what is a forester has changed over the years. According to viewpoint and situation, it has broadened, narrowed—and blurred.

The question is important. Many practical considerations come to focus on it. Eligibility for membership in the Society of American Foresters and the scope of its professional concerns is one. Qualifications for admission under a state forestry registration act is another. Use of the title itself is a critical matter. How broadly or narrowly, professionally or nonprofessionally, should it be used? Usage in large degree determines the image the public has of the profession—a matter of deep concern. Finally and fundamental to everything else, is definition of the nature, quality, and intensity of education to meet professional levels. The standing and solidarity of any professional group is determined by its educational standards.

A better answer to the question is needed for the same reasons that it is important. Some would have forestry restricted to timber use only, others would include almost everything having to do with trees; there are all gradations in between.

Can the question be answered? I think it can be—not perfectly, but with workable accuracy—and further that it must be if the profession is to continue its professional development and identity. I also think the best place to start in seeking an answer is to probe into what it is that has set apart and given foresters identity, what it is about their education and viewpoint that has made them useful citizens and leaders in many tree, forest, and general wildland undertakings.

I suggest that the distinguishing mark of a forester's training is a central core of sober concern with the ownership and management of forest lands. This comes in three closely related parts; the biological and physical sciences bearing on methods of perpetuating and taking goods and services from the forest, the social sciences dealing with the interrelations of men and the impact of their many needs on the forest, and finally, the integrative managerial combination of all skills into effective use of forest areas. The proportions can differ widely, but all three are there in some degree in a true forester. This does not at all exclude the need for and role of many specialists. Neither does it mean that every forester must be skilled in all areas of forest use. It does mean that he has strong anchor points in some uses and in one way or another gains this integrative sense of forest land management that he can develop and apply as ability and opportunity permit. In essence, it means going back to the forest and recognizing its perpetuation and use as the central concern.

Following this line of thinking can lead to conclusions at variance with tenets held by many foresters. First among these is a strong tendency to equate forest management with timber management. This is very natural. Timber use *is* the major use in total terms. Other uses are made possible by it and are largely exercised in relation to it through modification of cutting practice and related forest land treatment. Historically and educationally, forest management has been closely identified with timber management. It is embodied in our curriculums and should constitute a dominant part.

Nonetheless, can it be true that the basic virtue of a forester's education, that sense of forest land management he seems to get, is largely gained *through* well-coordinated development of a particular application—timber production? By its nature, it entails a rather full complement of land management problems and hence is an excellent medium. But isn't it essentially a medium, good as it is? And couldn't there be others?

If one accepts this view as having substance, then could not a man be truly a forester who has had no formal training in, let us say, applied mensuration, logging and milling, or even (and this hits very close to home)

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regulation of the cut? I would say yes, *provided* he gained comparable insight into forest land management problems through some other approach. In any event it would be assumed that he has had solid training in the ecology and perpetuation of the forest.

Can programs of education be devised that will give professional unity to the forestry profession and yet give due recognition to all forest uses in their place? In considerable degree we do this now, but this is not the place to get into the complexities of curriculum framing. I would, however, offer one suggestion to give substance to this discussion. It is to develop a forest land management course at a professional level designed to present squarely and without bias major uses of forest land resources, their interrelations, the realities of land ownership, and the problems of achieving balanced use in a changing social economy. This course should come early in the sequence of professional "use" courses and set the stage within which timber, wildlife, recreation, and other management courses can carry on.

Such a course would offer high challenge to give effectively and would necessitate adjustments in existing courses. It is no panacea and it is fully realized that the essence of a forester's education cannot be capsuled into any one-course or even a one-curriculum package. Land use cannot be taught with full rigor apart from its specific applications. But it is suggested that thought in this direction would cut to the core of the problem and pay large dividends.

Recognition of forest land resource management as the common ground and concern of a forester's training should give clarity and professional unity is answering the question: What is a forester?

KENNETH P. DAVIS

Professional Training Sessions of the North Louisiana Group of Foresters

Since the fall of 1957 the North Louisiana Group of Foresters has held four one-day professional training sessions. Plans are now under way for at least one more session during the fall of 1960 and for another session during the spring of 1961. A number of subjects are contemplated for future study. How these sessions came into being and how they operate is explained in the following paragraphs.

The North Louisiana Group of Foresters is an informal organization operating within the framework of the Society of American Foresters. The group was organized on January 29, 1941, in Winnifield, La., and has been meeting monthly since that time. It was founded as a service unit of the Society of American Foresters in order that the foresters in North Louisiana would have an opportunity to become better acquainted with each other, help each other work out solutions to mutual problems, determine ways of better administering and managing the forest lands of Louisiana, study and develop better utilization and harvesting methods for forest crops, and keep themselves advised of Society affairs.

In addition to these informal monthly meetings it was felt that special time and effort should be devoted to some of the more technical or professional problems facing the members. It was because of this thinking that one-day professional training sessions came into being where a specialist in a specific field was asked to come and give the group the benefit of his training and experience.

As is almost always the case in developing a new program there is one man to whom credit should be given. In this case the forester who initiated the idea to get these training sessions into being and who worked to make them a success was J. Scott McWilliams, chief forester, Union Producing Company, Monroe, La. In a letter of April 18, 1957, he put his thoughts into words as to why and what a professional training session should be. An excerpt from that letter follows:

"(1) Demand for intensive management and for so-called 'public-relation' type projects greatly limits the time available for self-study. (2) Publications and articles are being written in such volume that few foresters are able to assimilate sufficient information and still perform their existing duties. (3) Many new techniques are of such detail as to require formalized training to assure adequate use. (4) Existing meetings of Groups and Sections of the SAF do disseminate some technical information but are generalized and permit little true assimilation of knowledge, other than in a general manner. (5) Many industrial forest organizations are too small to permit an adequate staff for specialized fields (soils, statistics, management, etc.); the small

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organizations must ceaselessly work and study to keep abreast of new techniques. (6) The SAF has a mandated duty to keep its members up-to-date in practice. The Chapter, Section and National meetings are too large to do the job, because the basic requirement is for small groups, probably under fifty, to assure participation. It is my personal feeling that SAF Chapter and Section meetings should devote far more time to professional affairs and much less to technical matters. (7) A logical conclusion is that professional 'in-service' training (for want of a better term) can best be done by co-operation between SAF groups and such schools of Forestry as are available; this would provide a local flavor for training."

At its regular monthly meeting on July 8, 1957, the group was presented the idea of professional training sessions. After a full discussion on the matter the group voted unanimously to go into the program. A five-man committee was appointed with J. Scott McWilliams as chairman; R. E. Tucker, Continental Can Company, Hodge, La., as member representing the Winnfield-Hodge area; George Cunningham, Bodcaw Company, Minden, La., as member representing the Minden-Springhill-Shreveport area; E. A. Freeman, Olin Mathieson Chemical Corporation, West Monroe, La., as member representing the Monroe-Bastrop area; and Lloyd P. Blackwell, Louisiana Polytechnic Institute, Ruston, La., as ex-officio member and treasurer.

This committee outlined the operation of the training sessions as follows:

Sponsors.—The North Louisiana Group, Society of American Foresters, and the Department of Forestry of Louisiana Polytechnic Institute.

Purpose.—A professional training project developed for the primary benefit of members of the North Louisiana Group, SAF, to train professional foresters in new techniques and to develop greater professional skills.

Basic Concept.—Responsibility for the training project to rest jointly with Forestry Department of Louisiana Tech and the North Louisiana Group, SAF. All expenses to be borne by the participants.

Method of Operation.—(1) An overall planning committee of the North Louisiana Group to recommend method of operation and subjects for first year. (2) A committee for detailed planning of each meeting composed of one member of the North Louisiana Group and one member of the Forestry Department of Louisiana Tech. Given a desired subject, this committee would (a) Arrange for meeting date and facilities. (b) Arrange for speakers, instructors, field trip locations. (c) Accept application for attendance with power to accept or reject. (d) Publish such material as necessary after meeting. (3) Number of meetings each year should be limited—probably not more than four per year. (4) Subjects must be specific, not general, and must be capable of adequate coverage in a one-day session.

Under this program four professional training sessions have been held as follows:

October 10, 1957—Soil Site Classification by Robert Zahner, U. S. Forest Service, Crossett, Ark.

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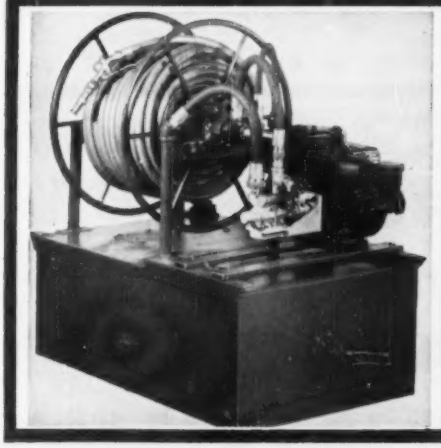

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February 27, 1958—Genetics-Tree Improvement by Bruce Zobel, North Carolina State College, Raleigh, N. C.

June 16, 1959—Continuous Forest Inventory by L. M. Oliphant, U. S. Forest Service, Atlanta, Ga.

January 12, 1960—Legal Problems in Forestry Operation by Randolph Brown, Shotwell and Brown, Attorneys, Monroe, La.

McWilliams served as Chairman from July 8, 1957, to December 4, 1959, on which date E. A. Freeman took over as chairman with the members remaining the same.

Each session has been limited to 30-40 participants depending on subject matter and facilities, and each one has been a sellout both in attendance and financially. The membership of the group is ready for new sessions whenever the committee completes the arrangements for them.

LLOYD P. BLACKWELL
Chairman, North Louisiana Group of Foresters, and Head, Department of Forestry, Louisiana Polytechnic Institute, Ruston

Central States Section Holds Annual Meeting

About one hundred members and guests attended the annual meeting of the Central States Section held October 13 and 14 at Franklin Park, Ill. The theme of the program was Forest Recreation.

Chairman H. F. Siemert presided at the business session. Reports were given as follows: on finances by Secretary-Treasurer W. O. Schramm; on membership by Bryan Clark, vice chairman; on legislation by E. E. Nuuttila; on publicity by J. D. Larson; and on Section history by E. V. Jotter. Henry Clepper, SAF executive secretary, reported on Society affairs.

A morning program devoted to forest recreation was preceded by a talk to the members by President Charles A. Connaughton. Noel B. Wysong presided at this session. Other speakers were Charles G. Sauers, general superintendent of the Cook County (Ill.) Forest Preserve District; Ronald Beasley of Southern Illinois University; M. M. Nelson of the U. S. Forest Service, and Harry Camp, also of the Forest Service.

James H. Tyndall was chairman of the program committee and director of the tour through the 47,000-acre Forest Preserve. A delightful lunch was served in Schillers Woods, courtesy of the American Walnut Association, whose chief forester George Romeiser gave a talk in the field.

The principal speaker at the Section dinner was Harry S. Mosebrook of Weyerhaeuser Company. His topic was "Recreation on Industrial Forest Land." William C. Bramble SAF Council member, also made brief remarks.

Chairman for the coming year, succeeding H. F. Siemert, is Bryan Clark of Bedford, Ind. The newly elected vice chairman is W. H. Hildebrand of Chillicothe, Ohio. W. O. Schramm of Alton, Ill., continues as secretary-treasurer.

The 1961 meeting of the Section will be held in southern Indiana in the fall.

Gilmore B. MacDonald (1883-1960)

Gilmore B. MacDonald, who served as a member of the Iowa State University staff for 50 years, died October 13, 1960.

Born at Carlton, Neb., March 9, 1883, he received the B. S. degree in 1907, the Master of Forestry degree in 1914, and the Doctor of Agriculture (Honorary) in 1947, all from the University of Nebraska.

He joined the Iowa State staff in 1910 as assistant professor of forestry, at the time when forestry was taught in the Department of Horticulture. When forestry became a department in 1946 MacDonald became its first head. He retired from administrative duties in 1948, but had remained on the staff of the University since that time.

Prior to going to Iowa State he had served with the U. S. Forest Service in Missoula, Mont., and in Washington, D. C.

Active in the affairs of the Society of American Foresters and The American Forestry Association, he was a recipient of a Distinguished Service Award from the latter organization in 1955 for his long and outstanding record in forestry education. The AMF citation spoke of him as "one of the most beloved teachers of forestry in the United States."

Mr. MacDonald served as Iowa deputy state forester from 1912 to 1933 and as state forester from 1933 to 1955. He was director of the Iowa Emergency Conservation Program which was part of the CCC program from 1934 to 1938, and was chairman of the National Forest Board of Review (later designated as the National Forest Advisory Council) appointed by the U. S. Secretary of Agriculture from 1948 to 1954.

He was secretary and later president of the Iowa Forestry and Conservation Association which became the Iowa Conservation Association. It was instrumental in spearheading the state park movement in Iowa and in achieving the consolidation of the old Iowa

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Fish and Game Commission and Iowa Parks Commission into the present Iowa Conservation Commission.

John R. Henry (1926-1960)

John R. Henry died in Atlanta, Ga. of a heart attack on September 5, 1960. Born on June 20, 1926, at Pittsfield Mass., Mr. Henry graduated from high school in his home town and then joined the U. S. Navy. Following service, he attended the University of Massachusetts, receiving a B. S. degree in forestry in 1949. He first went to work for the U. S. Forest Service on the Chattahoochee National Forest in 1950, later continuing his studies at Yale University where he received a Master degree in 1953.

Returning to the Forest Service, Mr. Henry was assigned to the Yazoo-Little Tallahatchie Flood Prevention Project in Mississippi. He continued in watershed and related work. His last assignment was in the Atlanta Regional Office of the Forest Service where he was staff specialist in the Watershed Section of the Division of Watershed, Wildlife, and Range Management.

Coming Events

Ozark and Kentucky-Tennessee Sections

The Ozark and the Kentucky-Tennessee Sections will hold a joint meeting December 2-3, 1960, at Memphis, Tenn.

Northern California Section

The Northern California Section will hold its winter meeting at the Jack Tar Hotel in San Francisco on December 10, 1960.

51st Western Forestry Conference

"Forest Frontiers in the Sixties" is the theme of the 51st Western Forestry Conference to be held by the Western Forestry and Conservation Association, December 7-9, 1960 at the Empress Hotel, Victoria, B. C.

SPCA Annual Meeting

The annual meeting of the Southern Pulpwood Conservation Association will be held at the Roosevelt Hotel, New Orleans, La., February 7-8, 1961.

Membership Applications and Advancements

Proposals for admission, advancement, and reinstatement received in the Society office during the month of October are listed below.

Action on the eligibility of those proposed for membership as listed below will be taken by the Council as of December 31, 1960.

Communications from the voting members regarding the membership eligibility of these persons should be received in the Society office prior to that date.

Alaska Section

Junior Grade

Ruff, D. D., Forester, USFS, Craig, Alaska. Mont. State, BSF, 1959.

Allegheny Section

Student Grade

PENNSYLVANIA STATE UNIVERSITY

Bull, J. R. Glass, R. N.
Perry, P. W.

Junior Grade

Brown, J. H., Asst. Silviculturist, West Va. Univ., Morgantown, West Va. West Va. Univ., BSF, 1953.

Mikulecky, J. P., Forester, Dept. Mines & Mineral Industries, Harrisburg, Pa. Pa. State, BSF, 1959.

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This book is intended for courses in forest pathology at the university level. In its two previous editions it was used extensively not only by students, but by practicing forest and plant pathologists, foresters, and timberland owners.

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Appalachian Section

Student Grade

DUKE UNIVERSITY

Bair, W. M.
Buehler, P. R.
Cade, S. C.
Cleaveland, J. A.
Eads, L. D.
Morris, G. A.
Rauschenberger, J. L.
Rex, R. L.
Sanden, R. M.
Smith, T. O.
Snider, A. J.

NORTH CAROLINA STATE COLLEGE

Brogden, R. O.
Buckley, W. B.
Craig, W. S.
Davis, K. L.
Foster, R. F.
Hayes, A.
Kinloch, B. B.
Liverman, F. L.
Moore, J. G.
Roberts, A. Y.
Simmons, L. G.
Smith, R. L.
Snider, L. B.
Spotts, J. W.
Turner, J. H.
Young, J. M.

Junior Grade

Menear, W. C., Unit Forester, International Paper Co., Georgetown, S. C. West Va. Univ., BSF, 1953.
Mosby, H. S., Prof., Va. Poly. Institute, Blacksburg, Va. (Reinstatement).

Affiliate Grade

Frazier, D. H., Forester, Va. Division of Forestry, Charlottesville, Va.

Central Rocky Mountain Section

Student Grade

COLORADO STATE UNIVERSITY

Braddock, A. A.
Dupree, G. G.
Hoffman, V. C.

Junior Grade

Campbell, D. I., General Dist. Asst., USFS, Meeker, Colo. Colo. State BSF, 1958.

Member Grade

Hessel J. N., Asst. Regional Forester, Denver Federal Center, Denver, Colo. (Reinstatement).

Associate Grade

Stein, E. W., Forest Supv., USFS, Gunnison, Colo.

Central States Section

Student Grade

PURDUE UNIVERSITY

Badger, M. L.
Bassett, R. E.
Berna, D. F.
Burgeson, C. M.
Cadle, R. L.
Cracium, G. J.
Crock, G. D.
Fisher, D. A.
Freund, F. W.
Hughes, M. Q.
Jacobson, C. L.
Kinerk, T. W.
King, P. W.
Platt, C. M.
Ray, J. D.
Reeves, G. W.
Rowe, R. T.
Scheetz, R. E.
Schwenke, R. G.
Walz, F. J.
Weedon, D. N.
Weimer, C. R.
White, D. J.
Wilson, J. H.
Winks, J. T.

Member Grade

Croxton, R., Farm Forester, Martin State Forest, Shoals, Ind. (Junior 52R55).
Ryker, R. A., R. R. #3, Elizabethtown, Ill. (Junior 1954).

Columbia River Section

Student Grade

OREGON STATE COLLEGE

Dix, R. G.
Worden, D. E.

Junior Grade

Donovan, J. K., Forester, USFS, Prospect, Ore. Univ. Wash., BSF, 1956.
Short, R. D., Forester, U. S. Dept. of Interior, Warm Springs, Ore. (Reinstatement).

Affiliate Grade

Skovlin, J. M., Range Conservationist, USFS, LaGrande, Ore.

Gulf States Section

Student Grade

LOUISIANA POLYTECHNIC INSTITUTE

Barth, B. R.	Rowell, G. D.
Butler, I. H.	Smith, W. D.
Chapman, J. P.	Taylor, J. M.
Chesnut, A. R.	Troquille, B. M.
Covington, P. H.	Underwood, P. N.
Garland, R. G.	Watts, T. H.
Harris, T. R.	White, J. D.
Hughes, C. M.	Wilkerson, A. H.
Lowery, H. A.	Woodard, J. M.
Lowrey, R. B.	Young, W. P.

LOUISIANA STATE UNIVERSITY

Bourgeois, G. W.	Meredith, J. B.
Broughton, J. D.	Smiley, W. L.

Junior Grade

Sandoz, J. R., International Paper Co., Nacogdoches, Texas (Reinstatement).

Affiliate Grade

Callahan, W. M., Forester, St. Regis Paper Co., Picayune, Miss.

Carter, C. E., Research Forester, Southern Forest Expt. Sta., New Orleans, La.

Hairston, T. H., Forester, Imes Tree Farm, Woodland, Miss.

Harris, T. H., Consultant Forester, James M. Vardaman & Co., Laurel, Miss.

Kentucky-Tennessee Section

Member Grade

Kneeza, N. S., USFS, Elizabethton, Tenn. Tenn. (Junior 1954).

Marshall, R. B., 1642 Estate Drive, Memphis, Tenn. (Junior 1954).

Myers, J. C., 109 Lind St., McMinnville, Tenn. (Junior 1954).

Schultz, R. J., Box 261, Whitely City, Ky. (Junior 1954).

Sell, C., Box 171, Tellico Plains, Tenn. (Junior 1954).

Stanford, J. M., 112 Mayor Ave., Greeneville, Tenn. (Junior 1954)

Thomas, C. S., 390 Sagasser St., Somerset, Ky. (Junior 1954).

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New England Section

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Childs, A. J.	Pare, M. R.
Fiske, P. R.	Perry, R. F.
Goodenough, R. D.	Sachsenmaier, W. M.
Stevens, R. A.	

UNIVERSITY OF MASSACHUSETTS

Babeu, R. G.	Johnson, P. P.
Boden, F. J.	Motyka, C. M.

UNIVERSITY OF NEW HAMPSHIRE

Kingsley, N. P.

Junior Grade

LaPage, W. F., Grad. Res. Asst., Univ. of New Hampshire, Durham, N. H. Univ. N. H., BSF, 1960.

New York Section

Member Grade

Engelken, J. H., Director, Tully Forest & Expt. Sta., Jamesville, N. Y. (Junior 1954).

Miller, H. C., Prof., College of Forestry, Syracuse, N. Y. (Junior 1954).

Potter, S. W., Director, Pack Forest, Warrensburg, N. Y. (Junior 1954).

Terrell, E. G., Supt., State Nursery, Ballston Spa. N. Y. (Junior 1954).

Valentine, M. F., Forester, St. Regis Paper Co., Star Lake, N. Y. (Junior 1954).

Walker, H. C., Area Conservationist, Soil Cons. Service, Syracuse, N. Y. (Junior 1954).

Northern California Section

Student Grade

UNIVERSITY OF CALIFORNIA

Briggeman, K. A.	McMenamy, D. W.
Crouse, R. O.	McNairn, R. B.
Hatlen, L. C.	Nilsson, J. R.
Johnson, R. K.	Roseberry, R. P.
Larson, G. B.	Youngberg, A. D.

Northern Rocky Mountain Section

Member Grade

Brackenbusch, A. P., Research Forester, Northern Forest Fire Lab., Missoula, Mont. (Junior 1954).

Grove, B. F., Resident Forester, Northern Pacific Railway Co., Seeley Lake, Mont. (Junior 1954).

Hudson, R. H., Forester, St. Regis Paper Co., Libby, Mont. (Junior 1954).

Matzner, F. T., Dist. Ranger, Flathead Nat'l. Forest, Condon, Mont. (Junior 1954).

McAvoy, R. T., Forester, Gallatin Nat'l. Forest, Bozeman, Mont. (Junior 1954).

Morgan, R. S., 141 4th Ave., East, Kalispell, Mont. (Junior 49R55).

Ozark Section

Student Grade

UNIVERSITY OF MISSOURI

Allen, R. P.	Mischon, R. M.
Cole, D. M.	Reaver, R. J.
Henson, R.	Richmond, G. B.
Holt, F. T.	Speckhart, A. K.
Johnson, M. M.	Staples, D. L.
Laacke, R. J.	Wakefield, W. C.
Lange, H. P.	Wilczynski, J. J.
Yost, C. R.	

Member Grade

Chancey, T. S., Mgmt. Forester, Dierks Forests, Inc., Mt. Pine, Ark. (Junior 52R55).

Simmons, B. J., Forester, USFS, Russellville, Ark. La. Poly. Tech., BSF, 1957 (Junior 1957).

Affiliate Grade

Mitchell, B. C., Forester, Pomeroy & McGowin, Monticello, Ark.

Puget Sound Section

Student Grade

UNIVERSITY OF WASHINGTON

Breum, T. N.	Sorenson, D. R.
Christensen, C. S.	Stedman, J. A.
Davis, D. L.	Summerlin, R. E.
Deer, T. E.	Swanson, H. A.
Hansen, D. L.	Taylor, R. N.
Kammenga, J. J.	Teagle, R. B.
Moorhead, W. W.	Vernon, J. R.
Wilson, R. G.	

Junior Grade

Baxter, W. C., Forester, Dept. of Natural Resources, Olympia, Wash. Univ. Wash., BSF, 1959.

McGowan, J. R., Self Employed, J. R. McGowan & Co., Inc., Seattle Wash. (Reinstatement).

Southeastern Section

Student Grade

AUBURN UNIVERSITY

Ayers, M. R.	James, R. J.
Bell, M. E.	Joiner, D. M.
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Davis, H. A. Morton, J. E.
Dinkins, J. R. Pennington, J. W.
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Elliott, K. A. Schwartz, R. W.
Gernt, C. E. Sherer, J. H.
Gowen, J. D. Smallwood, R. B.
Grabensteder, D. G. Sturdivant, B. R.
Hodgkins, P. E. Trice, J. H.
Howell, W. C. Williams, J. L.
Wright, W. M.

UNIVERSITY OF FLORIDA

Barsanti, R. A. Knudsen, W. R.
Croxton, E. A. Wade, E. V.
Gray, D. B. White, W. E.

UNIVERSITY OF GEORGIA

Edwards, O. C. Roller, W. O.
Payne, G. G. Waters, R. O.

Member Grade

Brinkman, G. L., Asst. Dist. Forester, Gulf States Paper Corp., Centreville, Ala. La. State, BSF, 1957 (Junior 1957).

Brister, J. C., Asst. Dist. Forester, Gulf States Paper Corp., Columbiana, Ala., (Junior 1954).

Darby, E. W., Forester, USFS, Talladega, Ala. Auburn Univ., BSF, 1955 (Junior 1955).

Loper, E. E., 1425 22nd Ave., Tuscaloosa, Ala. (Junior 1954).

Macke, W. J., 340 South Park Road, Birmingham, Ala. (Junior 1954).

Shipp, A. R., P. O. Box 254, Eutaw, Ala. (Junior 1954).

Affiliate Grade

Greene, J. C., Area Forester, Military Dept. State of Fla., St. Augustine, Fla.

Murphy, R. V., Farm Forester, Fla. Forest Service, Gainesville, Fla.

Southwestern Section

Junior Grade

Logan, J. F., Forester, USFS, Payson, Ariz. Pa. State, BSF, 1957.

Affiliate Grade

McGuire, O. B., Forestry Aid, USDA, Winslow, Ariz.

Upper Mississippi Valley Section

Student Grade

IOWA STATE UNIVERSITY

Boyle, J. R. Schneider, J. F.
Chapman, D. A. Schwartz, L. P.

Junior Grade

Bodenberger, P. E., Route 1, Box 118, Perry, Iowa. Iowa State, BSF, 1960.

Student Eligible for Automatic Advancement

IOWA STATE UNIVERSITY

Wisch, J. C.

Member Grade

DeBruin, H. W., 514 East Oxford St., Duluth, Minn. (Junior 1954).

Haff, A. S., Motel Moe-Del, Grand Marais, Minn. (Junior 53R55).

Hall, J. F., Nursery Supt., General Andrews Nursery, Willow River, Minn. (Junior 1954).

Mayrand, E. J., Forester, Iron Range Resources & Rehabilitation, Hibbing, Minn. (Junior 51R54).

Milanowski, N. V., Forester, Iron Range Resources, Hibbing, Minn. (Junior 1954).

Washington Section

Junior Grade

Heaton, P. L., Project Director, USFS, Washington, D. C., (Reinstatement).

Member Grade

Echols, R. M., Forester, Agricultural Research Service, Washington, D. C. (Junior 1954).

Grant, J. F., 609 Fern Lane, Annandale, Va. (Junior 36R55).

Zimmerman, E. W., Forester, USDA, Washington, D. C. (Junior 47R55).

Wisconsin-Michigan Section

Student Grade

MICHIGAN COLLEGE OF MINING & TECHNOLOGY

Kalk, P. A.

MICHIGAN STATE UNIVERSITY

Collins, A. F. Schumann, W. F.
Gaffney, J. A. Shereda, P. J.
Haller, T. E. Stercula, G. T.
Moulton, R. J. Stordeur, C. E.
Rivers, W. J. Vrabler, J. J.
Wagner, J. J.

UNIVERSITY OF MICHIGAN

Baker, B. H. Fraser, D. L.
Brandes, R. O. May, T. D.
Crawford, N. A. Misiak, R. D.
Fowler, R. F. Reuter, A. F.
Weizenicker, D. L.

Junior Grade

Emerson, C. R., Forester, Wis. Cons. Dept., Black River Falls, Wis. Mich. College of Mining & Tech., BSF, 1958.

No Section

Corresponding Grade

Angel-Maria Rodriguez Arregui, Chief Eng., Spanish Gov't., Huesca, Spain.

Angel Carrasco, Section Eng., Spanish Forest Service, Plasa de Espana, Spain.

Hisashi Chuma, Director of Forestry, Prefectural Gov't., Miyazaki-shi, Japan.

Juan Lopez Collado, Manager, Spanish Gov't., Guadalajara, Spain.

Kaichiro Fukucho, Manager, Iwate Prefectural Federation, Iwate-ken, Japan.

Jose Montero Garcia, Chief Eng., Spanish Gov't., Cuenca, Spain.

Takeyasu Ishikawa, Director, Ministry of Agriculture, Tokyo, Japan.

Takeji Kumimatsu, Prefectural Federation, Bragi, Japan.

Ricardo De Rada, Chief Eng., Spanish Forest Service, Madrid, Spain.

Florencio P. Mauricio, Instructor, Univ. of the Philippines, Diliman, Rizal, Philippines.

Seiji Miyazawa, Chief Gifu Prefecture Office, Gifu City, Japan.

Keima Suzuki, Gov't. Official, Aomori Prefectural Gov't., Nagasima Aomosi-si, Japan.

Rafael Menendez-De-La-Vega, Chief, Spanish Forest Service, Soria, Spain.

Katuyuki Wada, Chief, Oji Paper Co., Ltd., Tokyo, Japan.

Yoritada Yazawa, Director, Yamanashi Prefectural Gov't., Kofu City, Japan.

Toyonoshin Yoshimura, Chief, Yamaguch, Prefectural Gov't., Yamaguchi-shi, Japan.

Forestry News

American Forestry Association Holds Southern Meeting

The annual meeting of The American Forestry Association was held October 16-19 at Edgewater Park, Miss. Attendance was in excess of 400.

A beautiful pageant titled "Salute to America's Forests" opened the conference. Produced and directed by William Bergoffen of the Forest Service, it featured the Association's 85 years of conservation service.

President Don P. Johnston welcomed the members at the first morning session. The principal address was given by Senator John C. Stennis of Mississippi.

At the second session papers were given by Richard E. McArdle, chief of the Forest Service; by Frank Heyward of Crown Zellerbach Corporation; and by Voit Gilmore of the North Carolina Board of Conservation and Development.

A dinner on October 17 gave recognition to the several state and industrial associations active in southern forestry. R. Vance Miles was toastmaster; Arthur W. Nelson, Jr. was the principal speaker. The dinner was followed by a dance.

An all-day tour by bus was the feature on October 18. Visits were made to the bottomland hardwood tree farm of Albert Stewart, and to the plantations of Crown Zellerbach Corporation at Bogalusa, La., where the Corporation was host to a delightful luncheon.

The third and final day was devoted to indoor programs emphasizing fire prevention progress, outdoor recreation, the lumber industry, and Christmas tree production.

George A. Garratt of the Yale School of Forestry was toastmaster at the annual dinner on October 19. Kermit Roosevelt, vice president of Gulf Oil Corporation, was the speaker.

The AFA conservation award was presented to Maurice K. Goddard, secretary, Pennsylvania Department of Forests and Waters.

A special Boy Scout award was presented to the Association. Another award, by the American Motors Corporation, was presented to Don P. Johnston, AFA president, in recognition of his personal contribution in the field of conservation.

MRS. Katharine Jackson Lee, a director of The American Forestry Association, presents the Association's 1960 conservation award to Maurice K. Goddard, secretary, Pennsylvania Department of Forests and Waters.

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American Bar Association Appoints Committee on Timber and Vegetative Resources

The increasing importance of forests, tree farming, and multiple use of forest lands in the American economy was influential in the establishment of the Committee on Timber and Vegetative Resources in the American Bar Association's Section of Mineral and Natural Resources Law at the recent annual meeting of the ABA in Washington, D. C.

L. Clair Nelson, associate counsel of The Champion Paper and Fibre Company, Hamilton, Ohio, is chairman of the new committee.

In reviewing the job ahead for this committee, Nelson stated that one of the principal objectives would be to obtain recognition within the ABA of the problems involving timber, tree farming, and forest lands, and by that means to utilize the force of the ABA to advance proper recognition of the modern concept of timber as a replenishable natural resource. Also, he stated it is hoped that the committee may serve as a clearinghouse for legal information in this specialized but rapidly growing field.

Lawyers who are interested in this field, regardless of whether they are members of the American Bar Association, are urged to contact Nelson regarding the work of this committee.

Georgia Council Announces Expanded Research Efforts

A new research project in the field of genetics has been initiated by the Georgia Forest Research Council. The aim of this new program is to improve the techniques of grafting scion materials from selected trees to planted pines. New techniques of grafting are to be attempted in order to speed up the state's seed orchard program.

This new research program is directed by Dr. Claud L. Brown, associate professor, University of Georgia. Dr. Brown resigned his position as head of the Forest Genetics research program at Texas A. & M. in June of this year to move to Georgia to head up the new research program. After receiving his forestry degree at the University of Georgia in 1948, he worked with the Georgia Forestry Commission. In 1950 he became forester with Longleaf Lumber Company, of Buford, Ga. He later returned to the University and entered the Graduate School, where he received a Master in Botany. He received his Ph.D. from Harvard University.

Dr. Brown has his office and laboratory in the Biological Science Building at the new Science Center in Athens. His field work will be in the Georgia Forestry Commission's seed orchards and tree nurseries.

The new study is a cooperative program among the Georgia Forest Research Council, the Georgia Forestry Commission, and the School of Forestry and Botany Department of the University of Georgia.

Forest Utilization in the U. S. Studied by Spanish Foresters

Six forestry engineers from Spain and a high-ranking forester from Peru, visited several wood utilization operations in the U. S. in a study sponsored by the International Cooperation Administration with technical advice by the U. S. Department of Agriculture's Forest Service.

Following a visit to the Forest Products Laboratory, the group attended the Fifth World Forestry Congress at Seattle. They then inspected logging operations in southern states to see at first hand modern sawmilling operations and wood-using plants.

In the group were six field leaders in the Spanish Forest Service, graduates of the forestry engineering course at the National Forestry School in Madrid. The Peruvian member of the group is the ranking federal forester in his country, and a forestry graduate of the University of Michigan School of Natural Resources.

Technical leader for the study was E. L. Demmon, a 33-year member of the U. S. Forest Service until his retirement in 1957. Formerly president of the SAF, he is now a forestry consultant at Asheville, N. C.

1959 Pulpwood Production in South Reached Record High

Pulpwood production in the South during 1959 set a new, all-time record. According to the latest pulpwood survey, issued jointly by the Southern and Southeastern Forest Experiment Stations of the U. S. Forest Service, the total output of pulpwood in the South reached 22,750,100 cords, topping the old record set in 1956 by nearly 2.5 million cords. The survey was made in cooperation with the Southern Pulpwood Conservation Association.

Ten of the 12 southern states showed increases in pulpwood production, and for the twelfth year Georgia

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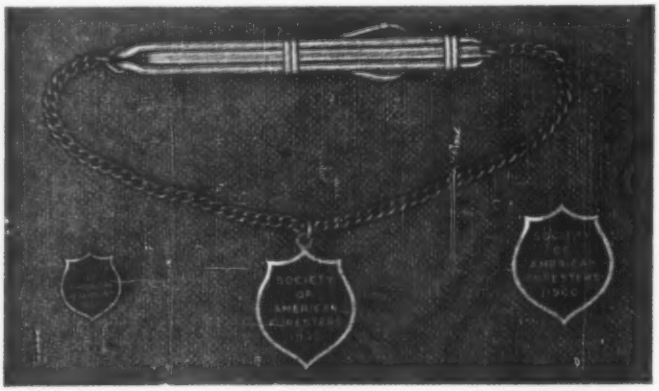

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led all others in output. Virginia showed the largest percentage increase in production over 1958, and only Oklahoma and Tennessee showed a decline.

Pine roundwood continues to dominate the southern pulpwood market. However, the use of hardwoods by the pulp industry has been expanding for the past decade. In 1959 hardwood production was up a record 28 percent from the previous year and accounted for 19 percent of the total roundwood harvest in the South.

Today some 600 southern plants, chiefly sawmills and veneer mills, are converting their residues to pulp chips. In 1959 they produced almost 2.4 million cords. Use of wood residues by the pulp and paper industry from all sources was 38 percent greater than in 1958.

Completion of a new pulpmill in South Carolina during 1959 brought the total in the South to 76, with a combined daily capacity of 46,112 tons of dry pulp. Florida, with 10 mills and 8,100 tons capacity, ranked first among the southern states, with Georgia and Louisiana second and third. By the end of the year, seven additional pulpmills were planned or actually under construction, and the announced expansion of existing plants will add still more production.

The report "1959 Pulpwood Production in the South" is available from the Southern Forest Experiment Station, New Orleans, La., or from the Southeastern Forest Experiment Station, Asheville, N. C.

South Carolina Group Considers Research Needs

The South Carolina Forestry Study Committee held two meetings during October to review the needs for a stepped-up program of forestry research in that state. On October 5 Director Joseph F. Pechanec of the U. S. Forest Service Southeastern Forest Experiment Station and other members of the Station staff discussed the role of forestry research in general and work in progress pertaining to the state. At a second meeting on October 12 the Committee heard Dr. K. Lehotsky of the Clemson College Forestry Department discuss research facilities and studies at Clemson; H. E. Ruark, director of the Georgia Forest Research Council, describe progress in that state where more than 60 forest researchers are now at work; and S. C. State Forestry Commission foresters E. C. Pickens and A. A. Lehocky present a resume of research efforts and needs of the Commission.

C. H. Niederhof of the West Virginia Pulp and Paper Co. is chairman of the Committee which is composed of state legislative representatives and governor's appointees.

Louisiana Forestry Association Meets

The Louisiana Forestry Association met in Alexandria on September 22 with more than 300 persons in attendance. Featured speakers were Dr. Edward Locke, director of the U. S. Forest Products Laboratory; Henry Malsberger, manager of the Southern Pulpwood Conservation Association; State Tree Farm Chairman Leonard Thomas; State Forester James E. Mixon; and State Senator A. C. Clemons.

Leon Walker was re-elected president of the Association.

Private & Industrial

Recent Personnel Additions Announced By Tennessee River Pulp & Paper Co.

A. K. Dexter, wood and land manager for the Tennessee River Pulp & Paper Co., has announced the following recent additions to the Wood and Land Division of the company.

With the Forest Management Department, under the supervision of W. W. Vickery, there are two new district foresters and one assistant district forester.

James W. Eckford III is assistant district forester at Red Bay, Ala. district. Joseph Black has been named district forester for the Ripley, Miss. district. James William Carpenter is district forester for the Fayette, Ala. district.

Joining the Wood Procurement Department, under the supervision of W. E. Gibbons, are three area procurement foresters. They are Maurice F. Hamm, H. K. Seymour, and Beryl G. Toler.

Each of the area procurement foresters has a group of conservation foresters working with him in his area. They will assist local private landowners with their forestry problems.

E. E. Senter Promotion Announced

Edgar E. Senter has been appointed northern division supervisor for wood procurement activities of West Virginia Pulp and Paper Company's Bleached Board Division.

In his new post, Senter will be in charge of six woodyards in the Gordonsville-Charlottesville-Lynchburg area of Virginia. His duties will include supervision of a staff of professional foresters who work with private landowners on land management and reforestation.

A 1951 graduate of New York State College of Forestry at Syracuse, Senter has been with West Virginia Pulp and Paper in forestry and wood procurement posts since 1956.

Schools

St. Regis Scholarship Announced

St. Regis Paper Company has announced the award of its undergraduate scholarship in forestry in the northeastern United States for the

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academic year 1960-1961 to John A. Martin, a forestry student at the State University of New York, at Syracuse, N. Y.

Mr. Martin was chosen by a committee consisting of Hamilton K. Pyles, regional forester, U. S. Forest Service, Upper Darby, Pa.; Dr. Ralph Marquis, director, Northeast Forest Experiment Station; and Paul M. Dunn, St. Regis director of forestry.

St. Regis annually awards five undergraduate scholarships in forestry —three in the South and one each in the Northeast and Northwest.

The Northwest award was made to James C. Space, a junior at the College of Forestry, University of Idaho.

Tree Nutrition Study Grant Made

The National Science Foundation has awarded a $48,900 grant to the University of Washington College of Forestry for a three-year study of tree nutrition.

Dr. Stanley P. Gessel, associate professor of forestry, who has been conducting research on this problem for the past 10 years, will be in charge of the project. Dr. Richard Walker, associate professor of botany, will be scientific adviser.

R. N. Colwell Honored for Photo Interpretation Work

Robert N. Colwell, authority on photo interpretation from the University of California's School of Forestry, Berkeley, was honored for his outstanding contributions to this field at the recent quadrennial World Congress of the International Society of Photogrammetry in London, England.

A paper prepared by the Berkeley professor was the feature address on photo interpretation at the meeting.

Entitled "The Photo Interpretation Picture in 1960," Dr. Colwell's paper surveyed the most significant developments in the field since the founding of the Society's Commission on Photo Interpretation in 1952.

He was lauded at the Congress for his editorship of the recently published *Manual of Photographic Interpretation*. The 900-page volume was prepared by more than 100 experts on photo interpretation under the auspices of the American Society of Photogrammetry.

The new laboratory of the Northern Institute of Forest Genetics at Rhinelander, Wis.

Public

L. F. Cronemiller Retires From Oregon Department

Lynn F. Cronemiller, public relations director for the Oregon State Forestry Department, retired on November 9 after nearly 37 years with the organization.

Cronemiller received his Bachelor degree in forestry from Oregon State College in 1914 and his Master in 1936. During his undergraduate years he was with the U. S. Forest Service and following graduation was engaged in private industry for a number of years.

He went to Salem as deputy state forester early in 1924 and continued in that position until 1930 when Oregon's first state forester, F. A. Elliott, died and Cronemiller was appointed to fill the vacancy.

In 1940 following a change in the political complexion of the state he was appointed assistant state forester in charge of forest land management. In this position he outlined and directed Oregon's multi-million-dollar forest rehabilitation project designed primarily to restoring the 250,000 acres of devastated state owned land in the historic Tillamook burn. Other activities included a program of land acquisition, timber sales, administration of Oregon's forest land tax law, land classification, and public relations.

Upon reaching the age of 65 he retired from the activities of the division and took over as publicity director, a position he has held for the past five years.

Cronemiller is planning to conduct a forestry consulting business and also continue writing his records concerning forestry in Oregon. He is a mem-

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ber of Phi Kappa Phi, scholastic honorary; Xi Sigma Pi, forestry honorary, and the Society of American Foresters.

Genetics Laboratory Dedicated in Wisconsin

A new laboratory at the Northern Institute of Forest Genetics, Rhinelander, Wis., was dedicated on September 30. The building is a major addition to the facilities of the U. S. Forest Service, Lake States Forest Experiment Station.

Dr. Paul Kramer, head, Department of Botany, Duke University, spoke at the dedicatory luncheon, outlining some of the research opportunities afforded by modern specialized facilities. Brief remarks were made also by M. B. Dickerman, director of the Lake States Station; Dean R. K. Froker of the University of Wisconsin; State Forester C. N. Nelson of North Dakota; Folke Becker, president, Trees for Tomorrow; Hon. Alvin E. O'Konski, Member of Congress; Purdue University forestry Dean William C. Bramble, Council Member representing the Society of American Foresters; and L. P. Voigt, director of the Wisconsin Conservation Department. A bronze plaque commemorating the event was unveiled by George M. Jemison, deputy assistant chief, Forest Service, Research. Dr. Hans Nienstaedt, geneticist-in-charge, was master of ceremonies.

THE dedication of the new research laboratory at Gulfort, Miss. The laboratory is a unit of the Southern Forest Experiment Station of the U. S. Forest Service.

Basic genetics research for the improvement of northern conifers and hardwoods by selection and hybridization is conducted at the Institute. The work is fundamental to field application throughout the northern forest area and the Northern Great Plains.

Callaham to Head Genetics Research at Pacific SW Station

Appointment of Dr. Robert Z. Callaham as chief of the Division of Forest Genetics Research was announced in September by Dr. Keith Arnold, director of the Pacific Southwest Forest and Range Experiment Station in Berkeley, Calif.

Before assuming his new duties Callaham was leader of the Forest Service's Inland Empire research center at Spokane, Wash. He succeeds F. I. Righter, who has been in charge of forest genetic studies at the Station since 1951 and a member of the Station research staff for 25 years.

Righter will continue with the Station, Dr. Arnold said, devoting full time to his own studies of methods to improve forest trees through hybridization and to publication of the results of past studies.

Southern Experiment Station Has New Research Laboratory

A new research laboratory at Gulfport, Miss., a unit of the Southern Forest Experiment Station, was dedicated on October 6. Two hundred friends and members of the Forest Service were present.

The building houses the Southern Institute of Forest Genetics together with the Station's forest insect laboratory and forest disease laboratory.

Philip A. Briegleb of New Orleans, director of the Southern Station, presided at the ceremonies. Participating on the program was Herman E. Baggenstoss, president of the Forest Farmers Association. The dedication address was given by Senator John C. Stennis of Mississippi.

Richard E. McArdle, chief of the

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Forest Service, declared the new center officially open, and presented the keys to Berch W. Henry, officer in charge of the Genetics Institute and resident leader of the center.

Forest Fire Research Continues to be Strengthened

The U. S. Forest Service has announced creation of a Division of Forest Fire Research at its Pacific Northwest Forest and Range Experiment Station. David Bruce, who has headed a similar division at the Southern Station for the past four years, has been transferred to Portland to head up research programs in Oregon and Washington. Bruce earned his Master degree in forestry from Yale University in 1937.

George R. Fahnestock, since January 1957 assistant fire research chief at the Southern Station, has been promoted to chief of that division. He is a 1938 Yale graduate.

The Southeastern Forest Experiment Station, which mans research facilities of the Southern Forest Fire Laboratory, built by the Georgia Forest Research Council near Macon, has announced the recent addition of a mechanical engineer and a chemist to the staff of the Laboratory.

Wyoming Forest Supervisor Changes Announced

George K. Brown, Medicine Bow National Forest supervisor at Laramie, Wyo., has moved to the Denver Regional Office of the U. S. Forest Service. He will head the Branch of Information and Education.

William E. Augsbach, supervisor of the Bighorn National Forest at Sheridan, Wyo., has succeeded Brown at Laramie; and David S. Johns, a member of the Medicine Bow Forest Staff at Laramie, transferred to Sheridan, succeeding Augsbach as Bighorn Forest supervisor.

Regional Forester Donald E. Clark announced these changes in assignment, effective in October, for the three Wyoming forest officers.

Brown received his forestry degree from North Carolina State College in 1930. He started his career in the Forest Service in 1931 on the Pike National Forest. He later served in various capacities in Colorado, South Dakota, and Nebraska, before leaving to serve with the Armed Forces in 1942. He was promoted to supervisor of the Arapaho Forest in 1952, where he remained until transferring as supervisor of the Medicine Bow in 1957.

Augsbach is a forestry graduate of Michigan State University. Early in his career, which dates back to 1937, he served as field assistant and technician with the Intermountain Forest and Range Experiment Station.. He has been Bighorn supervisor since October 1956.

David S. Johns received his forestry degree from Penn State College in 1940. He entered the Forest Service in 1944. In 1948, Johns was promoted to district ranger on the San Juan Forest in Colorado, where he remained until his transfer to the Black Hills National Forest at Newcastle, Wyo., in 1955. He was promoted and moved to the Medicine Bow Forest in Wyoming in 1958, where he has served as staff assistant until the present time.

Forestry Employment

S.A.F. members are privileged to insert one 60-word advertisement in this column without charge. Forest industries desiring to employ foresters may insert advertisements at the rate of $4 per column inch. Copy must be received by the end of this month for an advertisement to appear in the issue after next.

Obviously the Society cannot assume responsibility beyond making it possible for prospective employee and employer to enter into negotiations.

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Box B, Society of American Foresters, Mills Building, Washington 6, D. C.

Forester BSF, 1958, University of New Hampshire. Age 24, married, 2 children. 2 summers with USFS in Inland Empire as lookout and marking. 2½ years as service forester. Desire position in Rocky Mountain area, west coast or Alaska.

Box C, Society of American Foresters, Mills Building, Washington 6, D. C.

Forester, B.S.F., Utah State University, 1960. 23, married; four summers U. S. Forest Service. Presently employed by same organization. Timber sale preparation, appraisals, Fire control planning, fire weather research. Management plans. Recreation site planning and administration. Desire position with private industry or consulting firm in western U. S.

Box D, Society of American Foresters, Mills Building, Washington 6, D. C.

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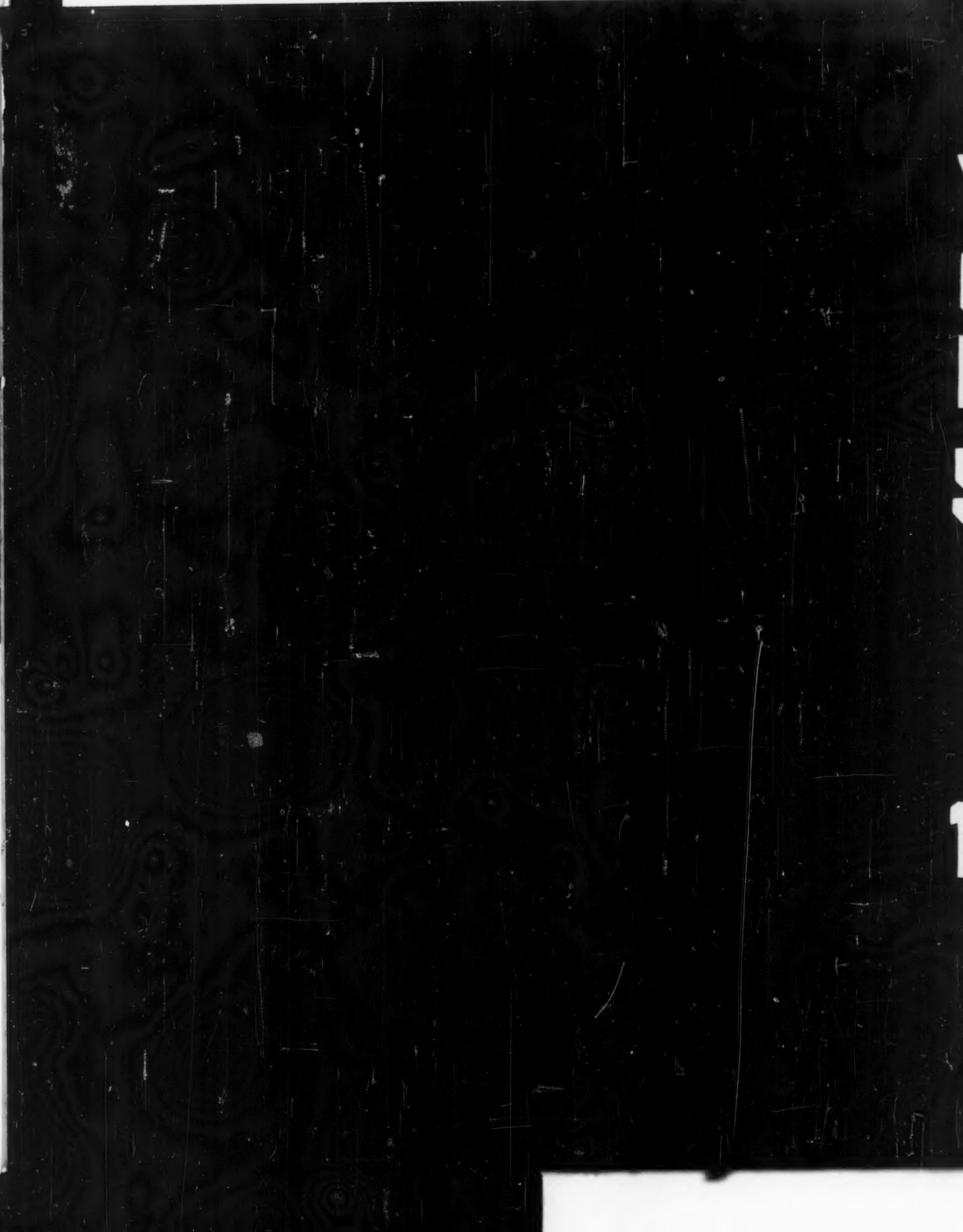
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